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CIVIL ENGINEERING.

*The Resistance of Flexure: On the existence of an element of Strength in Beams subjected to Transverse Strain, arising from the Lateral Action of the fibres or particles on each other.** By WILLIAM HENRY BARLOW, F. R. S.

(Continued from page 10.)

The foregoing experiments having shown that in girders containing the same depth of metal, the resistance arising from the lateral action of the particles depended on the amount of the flexure, I thought it desirable to make other experiments to ascertain how this resistance varied in girders having the same total depth, and consequently nearly the same deflection, but with different depths of metal in the girder. For this purpose, beams were cast of the forms Nos. 5, 6, and 7, each 4 inches deep, and with the upper and lower ribs, $1\frac{1}{2}$ inch by $\frac{3}{4}$-inch, the ribs being placed so that the depth of the metal in No. 5 was twice as great as in Nos. 6 and 7.

Four beams were cast of each form,—the exact dimensions and breaking weights are given in the Appendix,—and the mean results were as follows:—

Description of beam.	Depth of beam.	Depth of metal.	Sectional area.	Deflection.	Breaking weight.
Form No. 5,	4·04	3·01	2·320	·322	5141
Form No. 6,	4·04	1·48	2·230	·310	5147
Form No. 7,	4·07	1·56	2·380	·262	6000

* From the Lond. Civ. Eng. and Arch. Journ., May, 1856.

Obtaining the value of F from these experiments, and comparing them with beam No. 4, which had the same total depth, we have—

	Deflection.	Depth of metal.	Value of F.
Form No. 5,	·322	3·01	37,408
Form No. 4,	·301	1·97	28,032
Form No. 7,	·262	1·56	27,908
Form No. 6,	·310	1·48	25,271

The experiments did not afford so complete a comparison as the former series, because the intervals between the vertical ribs were not equal, nor in the same proportion to the depth of metal, the effect of which would be to vary to some extent the form of the curve of deflection. Nevertheless, they show in an equally decided manner, that when the deflection is the same the resistance increases when the depth of metal in the beam is increased.

The foregoing experiments have therefore elicited three facts as regards beams formed of two parallel bars separated at given intervals by vertical ribs :—

First, that in every case the resistance, or the value of F, is greater than that due to the tensile resistance of the metal.

Second, that with the same depth of metal in the beam, and the same distance of bearing, the resistance is greater when the deflection is greater.

Third, that with the same deflection and the same length of bearing, the resistance is greater when the depth of metal in the beam is greater.

And it follows from these results, that there is an element of strength depending on the amount of deflection in connexion with the depth of metal in the beam, or in other words, dependent upon the degree of flexure to which the metal forming the beam is subjected.

The existence of an element of strength in addition to the resistances to direct tension and compression being clearly proved by these experiments, it becomes interesting to ascertain the law under which it varies, in the form of beams experimented upon.

Now, if from the value of F, the tensile strength of the metal is deducted, it will be found that the remainder maintains nearly a constant ratio in each case to the depth of the metal in the beam multiplied by its deflection. It would appear, therefore, that the total resistance, or the value of F, is composed of two quantities; one being constant and limited by the resistance to direct tension, and the other varying directly as the degree of flexure to which the metal forming the beam is subjected.

The applicability of this simple law may be tested by the results of the experiments as follows :—

Let φ = the resistance to flexure in the solid beam at the time of rupture.

and let D = the depth ;

δ = the deflection ;

f = tensile resistance ;

and F = total resistance.

Then in the solid beam

$$f + \varphi = \text{F} ;$$

and let F′, D′, and δ', represent the total resistance, depth of metal, and deflection of any other of the beams; then, the lengths being equal, if

the resistance arising from the lateral action varies as the depth of metal into the deflection,

$$F' = f + \phi \frac{D' \delta'}{D \delta}.$$

The value of ϕ may be determined from this equation, applied to each of the experiments, in two ways; first, by supposing f to be a constant quantity; and, secondly, by supposing f and ϕ to have a constant ratio.

By the first mode, the whole of the errors of observation and irregularities of the strength of the metal would be accumulated in ϕ. By the second method, these irregularities will be divided between the values of f and ϕ.

Adopting, therefore, the second method, let 1 to m represent the ratio of f to ϕ: then

$$f = m\phi,$$

and $$m\phi + \phi \frac{D' \delta'}{D \delta} = F';$$

or $$\phi = \frac{F'}{m + \frac{D' \delta'}{D \delta}},$$

which ought to be a constant quantity in all the experiments.

We cannot obtain the deflections at the line of rupture, but they may be assumed to be proportional to the deflections with $\frac{9}{10}$ths of the breaking weights in each case.

Now, the value of F in the solid beam was found to be 41,709 lbs.; and the value of f, from the experiments on direct tension, was 18,750 lbs.: and as in the solid beam

$$f + \phi = F,$$

ϕ will be 22,959 lbs.,

and the ratio of ϕ to f will be as 1 to ·81.

For the purpose of comparison, I have deduced the value of f and ϕ, in solid beams, from the experiments of Mr. Hodgkinson on ten different descriptions of metal; the results of which are given in the following table (See p. 76):—

The mean ratio of ϕ to f in these metals appears to be as 1 to ·78. The metal used in my experiments was a mixture consisting of two-thirds of South Staffordshire No. 3, hot blast pig, and one-third old metal recast. As compared with Mr. Hodgkinson's experiments, its strength accorded nearly with that of the Carron iron No. 3, hot blast.

The mean ratio of ϕ to f, obtained from Mr. Hodgkinson's experiments, being as 1 to ·78, and from the experiments herein detailed being as 1 to ·81, we may consider f to be four-fifths of ϕ; and therefore

$$m = ·8.$$

Using the ratio, the values of ϕ and f, derived from the formula

$$\phi = \frac{F}{m + \frac{D' \delta'}{D \delta}}$$

and $$f = \phi m,$$

as applied to each of the experiments, are given below :—

$$\text{No. 1. } \phi = \frac{41709}{\cdot 8 + \frac{2\cdot 012 \times \cdot 670}{2\cdot 012 \times \cdot 670}} = 23{,}171 \text{ lbs.}, f = 18{,}537 \text{ lbs.}$$

$$\text{No. 2. } \phi = \frac{35386}{\cdot 8 + \frac{1\cdot 97 \times \cdot 510}{1\cdot 348}} = 22{,}904 \text{ lbs.}, f = 18{,}323 \text{ lbs.}$$

$$\text{No. 3. } \phi = \frac{31977}{\cdot 8 + \frac{2\cdot 01 \times \cdot 401}{1\cdot 348}} = 22{,}890 \text{ lbs.}, f = 18{,}312 \text{ lbs.}$$

$$\text{No. 4. } \phi = \frac{28032}{\cdot 8 + \frac{1\cdot 97 \times \cdot 301}{1\cdot 348}} = 22{,}606 \text{ lbs.}, f = 18{,}085 \text{ lbs.}$$

$$\text{No. 5. } \phi = \frac{37408}{\cdot 8 + \frac{3\cdot 01 \times \cdot 322}{1\cdot 348}} = 24{,}626 \text{ lbs.}, f = 19{,}501 \text{ lbs.}$$

$$\text{No. 6. } \phi = \frac{25270}{\cdot 8 + \frac{1\cdot 48 \times \cdot 310}{1\cdot 348}} = 22{,}167 \text{ lbs.}, f = 17{,}734 \text{ lbs.}$$

$$\text{No. 7. } \phi = \frac{27908}{\cdot 8 + \frac{1\cdot 56 \times \cdot 262}{1\cdot 348}} = 25{,}302 \text{ lbs.}, f = 20{,}242 \text{ lbs.}$$

Description of iron.	Transverse strength of bar 1 in. sq. and 54 ins. between the supports.	Tensile strength per sq. inch.	Value of $f+\phi$ from the formula $w=\frac{2ad\,(f+\phi)}{3l}$.	Value of ϕ from the formula $w=\frac{2ad\,(f+\phi)}{3l}$. $\phi=\frac{3lw}{2ad}-f$.
	lbs.	lbs.	lbs.	lbs.
Carron iron No. 2, cold blast,	476	16,683	38,556	21,873
" " " 2, hot "	463	13,505	37,503	23,998
" " " 3, cold "	446	14,200	36,126	21,926
" " " 3, hot "	527	17,755	42,687	24,932
Devon " " 3, " "	537	21,907	43,497	21,590
Buffery " " 1, cold "	463	17,466	37,503	20,037
" " " 1, hot "	436	13,434	35,316	21,882
Coed-Talon " 2, cold "	413	18,855	33,453	14,598
" " 2, hot "	416	16,676	33,696	17,020
Low Moor " 3, cold "	467	14,535	37 827	23,292
Means, ...	464	16,502	37,616	21,114

These results, though not exhibiting a complete regularity, are sufficiently uniform to indicate that the assumed law of the variation of this resistance is a close approximation to the truth. It will be observed also, that Nos. 2, 3, 4, and 6, give a smaller value of ϕ than Nos. 1, 5, and 7, which probably arises from the difference in the proportion which the distance between the vertical ribs bears to the depth of the metal, a cir-

cumstance which would affect, to some extent, the form of the curve of deflection.

In the formula

$$\phi = \frac{F'}{m + \frac{D'\,\delta'}{D\,\delta}}$$

$\frac{D'\,\delta'}{D\,\delta}$ represents the ratio of the depth of metal in each beam multiplied by its deflection, to the depth of metal in the solid beam multiplied by its deflection. But the deflections, as might have been expected from known laws, were nearly in the inverse ratio of the total depths of each girder; therefore, the degree of flexure, and consequently the resistance to flexure in each, will be nearly as the depth of metal divided by the total depth of the girder, and we are thus enabled to obtain a formula for computing, approximately, the breaking weights of these girders, without first ascertaining their deflection.

Using the same letters as before, we have, for the resistance due to tension,

$$\frac{2a}{3l}\left(d + c + \frac{c^2}{d}\right) f;$$

and for the resistance to flexure,

$$\frac{2}{3}\frac{a}{l}\left(d + c + \frac{c^2}{d}\right)\frac{\phi D}{d};$$

and consequently, for the united effect of the two resistances,

$$W = \frac{2}{3}\frac{a}{l}\left(d + c + \frac{c^2}{d}\right)\left(f + \frac{\phi D}{d}\right).$$

I shall therefore conclude these observations by comparing the breaking weights computed for tensile resistance alone, and those obtained from the formula which includes the resistance to flexure, with the actual breaking weights obtained by the experiments, taking the value of

$f = 18{,}750$ lbs., and $\phi = 23{,}000$ lbs.

Description of beam or girder.	Breaking weight if resistance depended on direct tensile strength.	Breaking weight computed by the formula, including the resistance to flexure.	Breaking weight as obtained by the experiments.
	lbs.	lbs.	lbs.
No. 1 .	849	1890	1888
No. 2 .	1308	2567	2468
No. 3 .	1808	3287	3084
No. 4 .	2912	4659	4353
No. 5 .	2578	4935	5141
No. 6 .	3819	5533	5147
No. 7 .	4031	5919	6000

The accordance exhibited by the computed and the actual breaking weights, evinces the general accuracy of the formula, as applied to this

form of beam; while these results, compared with those computed for direct tensile force alone, show how large a proportion of the strength of cast iron, when subjected to transverse strain, is due to the resistance arising from the lateral action.

It will also be seen that comparisons of the relative strengths of different forms of section, calculated, as has been customary, on the assumption that the resistances are constant forces, or governed by a constant coefficient, must be entirely fallacious.

—

It was my intention to have included in this paper a similar investigation as to the position of the neutral axis, and the amount of the resistance arising from lateral action of the fibres in wrought iron; but as the experiments will take some time to complete, and as the facts elicited in reference to cast iron are of sufficient importance to render it desirable that they should be made known, I will reserve the examination of wrought iron for the subject of another communication.

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APPENDIX.

GIRDER No. 1.

	Exp. No. 1.	Exp. No. 2.	Exp. No. 3.	Exp. No. 4.
	inches.	inches.	inches.	inches.
Depth, . . .	2·015	2·02	2·073	2·040
Thickness, .	·975	·98	1·030	·990
Area of section,	1·965	1·98	2·135	2·020
Weight applied, lbs.	Deflection.	Deflection.	Deflection.	Deflection.
40	·015	·013	·014	·014
376	·145	·115	—	—
600	·203	—	—	—
712	·280	·233	·264	·244
936	·330	—	—	—
1160	·490	·420	·397	·414
1608	·725	·625	·579	·614
1664	·755	·655	—	—
1720	Broke.	·680	·629	·659
1832	. . .	·737	·679	·734
1888	. . .	Broke.	·699	·764
1916	. . .	. . .	—	Broke.
1944	. . .	. . .	·734	. . .
2000	. . .	. . .	·762	. . .
2028	. . .	. . .	·774	. . .
2056	. . .	. . .	·789	. . .
2084	. . .	. . .	Broke.	. . .
Breaking weight, lbs.	1664	1888	2084	1916
Deflection with 9-10ths of breaking weight, inches.	·643	·667	·699	·670

GIRDER No. 2.

	Exp. No. 1.	Exp. No. 2.	Exp. No. 3.	Exp. No. 4.
	inches.	inches.	inches.	inches.
Total depth, .	2·54	·253	2·49	2·50
Depth between upper & lower ribs,	·56	·55	·51	·55
Area of top rib,	1·00	1·00	·57	·98
" bottom "	1·01	1·00	·99	·97
Weight applied, lbs.	Deflection.	Deflection.	Deflection.	Deflection.
40	·009	·007	·007	·007
712	—	·132	·132	·137
804	·199	—	—	—
1292	·304	—	—	—
1516	—	·302	·319	·312
1740	·414	—	—	—
1852	—	·372	—	—
1964	·489	·397	·426	·433
2076	—	·427	—	—
2188	Broke.	·445	·479	·487
2300	. . .	·479	·526	·532
2412	. . .	·512	Broke.	·550
2524	. . .	·542	. . .	Broke.
2636	. . .	·575		
2748	. . .	Broke.		
Break'g weight, lbs.	2188	2748	2412	2524
Deflection with 9-10ths of breaking weight, inches.,	·489	·532	·482	·516

GIRDER No. 3.

	Exp. No. 1.	Exp. No. 2.	Exp. No. 3.	Exp. No. 4.
	inches.	inches.	inches.	inches.
Total depth, . .	3·02	3·00	3·00	3·00
Depth between upper and lower ribs, .	·98	1·00	1·01	1·01
Area of top rib, .	1·03	1·02	·97	1·01
" bottom " . .	·99	·98	1·01	·97
Weight applied, lbs.	Deflection.	Deflection.	Deflection.	Deflection.
40	·006	·005	·005	·005
712	—	·085	·085	·085
844	·113	—	—	—
1516	·216	·185	·197	·195
1740	·248	—	—	—
2188	·328	—	·297	·293
2300	—	·295	—	—
2524	·388	—	—	—
2636	·418	—	·363	·375
2748	·433	·377	—	—
2972	·483	·410	·423	Broke.
3028	Broke.	·425	·438	
3084	. . .	·435	·452	
3112	. . .	·437	Broke.	
3224	. . .	Broke.		
Breaki'g weight, lbs.	3028	3224	3112	2972
Deflection with nine-tenths of breaking weight, inches,	·435	·402	·397	·371

GIRDER No. 4.

	Exp. No. 1.	Exp. No. 2.	Exp. No. 3.	Exp. No. 4.
	inches.	inches.	inches.	inches.
Total depth, . .	3·99	4·00	3·99	4·01
Depth between upper and lower ribs, .	2·00	2·03	2·05	2·04
Area of top rib, .	1·00	·97	·98	·98
" bottom " .	1·00	·99	·98	1·01
Weight applied, lbs.	Deflection.	Deflection.	Deflection.	Deflection.
40	·002	·002	·002	·003
712	·047	·040	·048	·058
1516	·104	·097	·102	·108
1964	·134	—	—	—
2188	·161	·155	·155	·148
2636	·199	·197	·185	·183
3084	·227	·227	·223	·218
3420	—	·259	—	—
3532	·269	·267	·255	·253
3756	·299	·282	·285	—
3980	·317	·312	·300	·303
4092	·329	·320	·307	—
4148	·336	·322	·313	—
4204	Broke.	·327	Broke.	—
4260	. . .	Broke.	. . .	·333
4316	. . .	. . .	. . .	—
4400	. . .	. . .	. . .	·343
4428	. . .	. . .	. . .	—
4745	. . .	. . .	. . .	Broke.
Break'ng weight, lbs.	4204	4620	4204	4745
Deflection with nine-tenths of breaking weight, inches, . .	·297	·293	·282	·331

GIRDER No. 5.

	Exp. No. 1.	Exp. No. 2.	Exp. No. 3.	Exp. No. 4.
Total depth, ...	ins. 4·02	ins. 4·05	ins. 4·05	ins. 4·04
Depth between upper and lower ribs, . . .	1·04	1·04	1·04	1·09
Area of top rib, . . .	1·125	1·16	1·14	1·22
Area of bottom rib, .	1·162	1·13	1·15	1·20
Weight applied, lbs.	Deflection.	Deflection.	Deflection.	Deflection.
712	Deflections uncertain from imperfect fastening of the cord.	—	—	—
1516		—	—	—
2188		—	—	—
2290		·133	·148	·138
2636		—	—	—
2885		·173	·182	·178
3084		—	—	—
3445		·213	·221	·223
3532		—	—	—
3980		—	—	—
4005		·268	·270	·259
4428		—	—	—
4565		·313	·320	·303
4652		—	—	—
4705		·323	·335	—
4845		·348	·350	·335
4876		—	—	—
4927		—	—	—
4985		·345	Broke.	·340
5008		—	—	—
5050	Broke.	—	—	—
5125	—	Broke.	—	·355
5265	—	—	—	·365
5405	—	—	—	Broke.
Breaking weight lbs.	—	5125	4985	5405
Deflection with 9-10ths of breaking weight, inches.	—	·321	·313	·331

GIRDER No. 6.

	Exp. No. 1.	Exp. No. 2.	Exp. No. 3.	Exp. No. 4.
Total depth, ...	ins. 4·02	ins. 4·05	ins. 4·03	ins. 4·06
Depth between upper and lower ribs, . .	2·52	2·55	2·56	2·61
Area of top rib, . .	1·13	1·18	1·08	1·10
Area of bottom rib,	1·13	1·09	1·11	1·10
Weight applied, lbs.	Deflection.	Deflection.	Deflection.	Deflection.
712	Deflections uncertain from the same cause as Experiment 1, No. 5.	. .	. .	. .
1516		. .	. .	. .
2188		. .	. .	. .
2290		·130	·138	·138
2636		. .	. .	. .
2885		·168	·186	·175
3084		. .	. .	. .
3445		·205	·220	·222
3532		. .	. .	. .
3980		. .	. .	. .
4005		·251	·263	·272
4428		. .	. .	. .
4565		·300	·313	·313
4652		. .	. .	. .
4845		·315	Broke.	·350
4876		. .	. .	. .
4988		. .	. .	·365
5180		. .	. .	. .
5125	. . . .	Broke.	. .	·378
5212	Broke.	. .	. .	. .
5265	. . . .	. .	. .	·382
5405	. . . .	. .	. .	Broke.
Break'g weight, lbs.	. . . .	5125	4845	5405
Deflection with 9-10 break'g weight, ins.	. . . .	·298	·293	·340

GIRDER No. 7.

	Exp. No. 1.	Exp No. 2.	Exp. No. 3.	Exp. No. 4.
Total depth, ...	ins. 4·05	ins. 4·10	ins. 4·08	ins. 4·05
Depth between upper and lower ribs, .	2·50	2·51	2·51	2·52
Area of top rib, . .	1·19	1·26	1·21	1·16
Area of bottom rib,	1·19	1·19	1·17	1·16
Weight applied, lbs.	Deflection.	Deflection.	Deflection.	Deflection.
2290	·105	·105	·095	·090
2885	·115	·130	·120	·125
3445	·150	·160	·140	·160
4005	·185	·185	·180	·182
4565	·217	·215	·215	·210
5125	·255	·250	·235	·237
5405	·272	·267	. .	. .
5685	Broke.	·285	·270	·272
5825	. .	·292	. .	Broke.
5965	. .	·305	Broke.	. .
6105	. .	·310	. .	. .
6245	. .	·320	. .	. .
6385	. .	·330	. .	. .
6525	. .	Broke.	. .	. .
Break'g weight, lbs.	5685	6525	5965	5825
Deflection with 9-10 break'g weight, ins.	·252	·297	·253	·246

Summary of the Experiments on Transverse Strength, giving the mean results.

	Depth.	Sectional area.	Distance between the ribs.	Breaking weight.	Deflection with nine-tenths of breaking weight.
	inches.	sq. ins.	inches.	lbs.	inch.
Form of beam No. 1 . . .	2·015	1·965	—	1664	·643
	2·020	1·980	—	1888	·667
	2·073	2 135	—	2084	·699
	2·040	2 020	—	1916	670
Mean	2·012	2·025	—	1888	·670
Form of beam No. 2 . . .	2·54	2·01	·56	2188	·489
	2·53	2·00	·55	2748	·532
	2·49	1·96	·51	2412	·482
	2·50	1·95	·55	2524	·516
Mean	2·51	1·98	·54	2468	·510
Form of beam No. 3 . . .	3·02	2·02	·98	3028	·435
	3·00	2·00	1·00	3224	·402
	3·00	1·98	1·01	3112	·397
	3·00	1·98	1·01	2972	·371
Mean	3·01	2·00	1·00	3084	·401
Form of beam No. 4. - - -	3·99	2·00	2·00	4204	·297
	4·00	1·96	2·03	4260	·293
	3·99	1·96	2·05	4204	·282
	4·01	1·99	2·04	4745	·331
Mean - - - -	4·00	1·98	2 03	4353	·301
Form of beam No. 5. - -	4·02	2·287	1·04	5050	—
	4·05	2 290	1·04	5125	·321
	4·05	2·290	1·04	4985	·313
	4·04	2·420	1·00	5405	·331
Mean - - - -	4·04	2·322	1·03	5141	·322
Form of beam No. 6. - -	4·02	2 26	2·52	5212	—
	4·05	2·27	2·55	5125	·298
	4·03	2·19	2·56	4845	·293
	4·06	2·20	2·61	5405	·340
Mean - - - -	4 04	2·23	2·56	5147	·310
Form of beam No. 7. - -	4·05	2·38	2·50	5685	·252
	4·10	2·45	2 51	6525	·297
	4·08	2·38	2·51	5965	·253
	4·05	2·32	2 52	5825	·246
Mean - - - -	4·07	2·38	2·51	6000	·262

Experiments on Direct Tension.

No. of Experiment.	Sectional area at the place of fracture.	Last weight supported.	Weight with which the bar broke.	Remarks.
	inches.	lbs.	lbs.	
1	1·0506	18,560	18,840	A small air-bubble.
2	1·0557	19,680	19,960	" "
3	1·0100	21,360	21,580	" " at corner very small.
4	1·0364	16,320	16,320	Honey-combed.
5	1·0301	17,440	17,440	Sound.
6	1·0403	16,320	17,440	A small air-bubble.
7	1·0150	21,640	21,920	Sound.
8	1·0200	22,200	22,470	"
Mean,	1·0323	19,190	19,486	

Mean greatest weight supported, per inch, . 18,590 lbs.
Mean weight which broke the bar, per inch, 18,876 lbs.

Considering the actual breaking weight to be between these two, and rather nearer the latter, when due allowance is made for the small air-bubbles, the mean breaking weight may be taken at 18,750 lbs. per square inch.

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*On the Junction of the Atlantic and Pacific Oceans, and the Practicability of a Ship Canal, without Locks, by the Valley of the Atrato.** By Mr. F. M. Kelley, U. S. (America.)

[Abstract of paper read at the Institution of Civil Engineers, April 22, 1856.]

It was stated that the consideration of this subject had become urgent, and the adoption of some definite plan indispensable, in consequence of the commercial activity, which had resulted from the discovery of gold in California, and in Australia, and the rapid development of trade, throughout the whole of the Pacific. But the very extension of trade had introduced new elements into the problem: the larger dimensions now given to ships, and the increasing value of time, rendered it necessary that the proposed communication should be of a sufficient width and depth, to permit the passage of the largest class of vessels, and that it should, if possible, be constructed without locks, so as to insure economy of time, as well as of distance. It then gave a brief review of the different routes hitherto proposed, and the objections to which they were open.

The Tehuantepec route would require 150 locks; even then it would be 210 miles in length, and great improvements would be necessary in the harbors at both ends. The very unsettled state of the government in Mexico, rendered this undertaking most hazardous at the present time.

The Honduras route, 160 miles in length, was open to the same objection as to locks; the summit level was very high, 2681 feet above the sea; and, moreover, sufficient water could not be obtained, for the number of locks required.

The Nicaragua route, 194 miles in length, would have twenty-eight locks; the river San Juan would require to be deepened throughout; 47 miles of additional canal must be made; great improvements must be effected in the harbor of Greytown, and a new harbor altogether constructed on the Pacific. The modification of this project, by which the port of Realeja, would be the terminus on the Pacific, would increase the distance above 100 miles, and require great additional lockage, which it was very doubtful, whether the Lake Leon could supply.

The Chiriqui route was considered utterly impracticable, by M. Hellert, who found that the supposed passage through the mountains, offered the most formidable difficulties.

The Panama route would require thirty-six locks and six aqueducts, and the approaches on either side, would demand vast alterations to adapt them to the present wants of commerce.

The San Blas, or Mandingo Bay route, had never been sufficiently explored, on account of the decided hostilities of the Indians; moreover,

* From the Lond. Artizan, June, 1856.

that part of the Atlantic was beset with reefs and shoals, and there was every reason for believing that there was no depression in the mountain range.

The Darien route was only partially explored by Mr. Lionel Gisborne, who reported favorably of its capabilities; but subsequent expeditions had invalidated these conclusions, and tended to demonstrate that the Sierras Lloranas, formed an unbroken chain from the Gulf of San Blas to the Gulf of Darien. All explorers agreed on the decided hostility of the Indians, and, with the exception of Dr. Cullen, who averred that he had repeatedly crossed the Isthmus at that point, no subsequent explorer had succeeded in traversing it. It was proposed to construct a canal, without locks; but the great difference in the height of the tide at the two extremities (25 to 30 ft. in the Pacific, and only 2 ft. in the Atlantic), would produce a tidal current of such force as to endanger the works, and materially interfere with navigation.

The Atrato route had already been pointed out by Humboldt, as likely to afford one of the best solutions of the problem. It was stated that the River Atrato flowed almost due north for a length of 300 miles, in the midst of a vast alluvial plain between two ranges, resulting from the bifurcation of the Andes; it then discharged itself by nine mouths into the Atlantic, by the Bay of Candelaria in the Gulf of Darien. The upper part of the river had been carefully explored by Messrs. Trautwine and Lane, who had both reported against the feasibility of any plan for uniting the head waters of the Atrato, with those of the San Juan, which flowed into the Pacific. An exploration on the Pacific side, led to the discovery of a depression in the mountain chain, between Punto Ardita and Punto Marzo, which was found to correspond in an almost direct line eastward with the Truando, one of the most considerable western affluents of the Atrato.

The route more especially advocated in the paper, would commence on the Atlantic side, at the estuary of the Atrato, by widening and deepening one of its entrances, removing the sand bars, and stopping up, by breakwaters and dams, the remaining mouths, so as to direct the full force of the current, into the branch called Cañ› Coquito, or an entrance might be effected by a side cut from the bay into one of the mouths, and the erection of guard gates at each end; by stopping the current, would prevent any deposit or bar outside. At the distance of two miles from the mouth of the river deepened to 30 ft.: and from this point to the mouth of the Truando, was no where less than 47 ft., with an average width of 350 yards. It was then proposed to follow the Truando for 36 miles, deepening and widening its channel where required, to a point named Townsend's Junction. Up to this point the works required, would be very simple, as the banks were principally levels, formed of sedimentary deposit, and the soil of the bed of the river was of the same character. From Townsend's Junction an open cut was contemplated, for a distance of 13 miles. It was then proposed to tunnel through the base of the ridge, a length of $3\frac{1}{4}$ miles. A double tunnel was recommended, as the width (200 ft.) would require a single arch of too great a height; the division into two arches would also have the advantage of precluding any possibility of collision. The height proposed (120 ft.) would be sufficient to

allow of the passage of the largest vessels, by merely lowering their topmast. From the tunnel of the Pacific, a distance of 8 miles, the canal would follow the valley of a small stream, and debouch into Kelley's Inlet.

The line would thus uninterruptedly proceed, without locks, direct south, from the Bay of Candelaria to the junction of the Atrato, 7° 15′ N. Lat. and 77° 8′ 32″ W. Long.—a distance of 67 miles, 1436 yards, whence it would diverge by the Truando to the south-west, and terminate at the Peninsular of Paracuchichi or Kelley's Inlet, 6° 57′ 32″ N. Lat. 78° W. Long.—a distance of 63 miles, 1216 yards. It would thus have a total length of 131 miles, 892 yards, with a minimum width and depth throughout of 200 ft. and 30 ft. respectively. The most important point to be considered, was the rate and direction of the flow of water from the junction of the Truando with the Atrato, and the supply which might be depended on at that point. It had been ascertained by Colonel Totten, the Engineer of the Panama Railway, that the mean level of the two oceans was very nearly, if not entirely, similar. The difference in the height of the tides at the two extremities of the proposed route, was found to be,—at the entrance of the new river in the Pacific 12 ft. 6 in. at spring tides, and 10 ft. 11 in. at neap tides,—while the tidal wave of the Atlantic, at the mouth of the Atrato, never exceeded 2 ft. at any phase of the moon. After careful observation, Captain Kennish had fixed the height of the junction at 15·2 ft. above the mean tidal level of the two oceans.

The junction of the Truando with the Atrato, would thus be 9 ft. above the Pacific at the highest tide, and would flow down it with a velocity equal to that head; while, at the lowest tide, the velocity would be equal to a head of 21·45 ft. The summit being at the same height from the mean level of either ocean, and the distance being nearly equal, their average rate of current would be nearly the same,—about 2½ miles per hour. As far as theory could elucidate the tidal influence of the Pacific, it would extend to Townsend's Junction, and pass under the fresh water coming down the river, without commotion, either at flood or ebb. That part of the river between Townsend's Junction and the Pacific, would be slightly agitated by the rise and fall of the tide, but the velocity of the current would be scarcely affected.

By careful calculation it had been ascertained, that the discharge of the Atrato was 667,014,600 cubic ft. per hour, and the mean discharge of the new river would be about 42,000,000 cubic ft. Now, if this were taken solely from the bed of the Atrato, it would only reduce that river one-sixteenth, and its surface level 3¾ ft., the Atrato being 58 ft. deep at the point of junction with the Truando.

The principal advantages which gave the proposed route the preeminence over all others, were claimed to be:—

1st. That the two oceans could be thus united, by an open channel without locks or any other impediment.

2d. That the width and depth would be sufficient to allow of the simultaneous passage, up and down, at all times, of the largest class of vessels.

3d. That excellent harbors existed at both ends, requiring but little improvement, and at all times perfectly accessible.

4th. That the route passed through a country in undisputed possession of a legal government, and among a people favorable, instead of hostile to the undertaking.

A summary of the estimated cost of the canal, including the works of every kind throughout its whole length, with lighthouses, piers, depôts, &c., as also the execution, medical and commissary departments, was annexed to the paper. The total, including all contingencies, was fixed at 145,407,042 dollars, or £30,000,000. In constructing the canal of a width sufficient for the passage of one ship at a time, the estimate would be reduced nearly one half.

The vast saving in time and distance, which would be effected by this canal, was then dwelt upon. From New York to San Francisco, it would be no less than 13,000 miles, and proportionately large for all the ports in the Pacific. Details were given of the rapid development of trade which was annually increasing between great Great Britain, France, and the United States—and the Pacific; and also an approximate calculation of the commercial value of the canal.

In conclusion the author repeated, that the plan developed was, perhaps, not the only practicable one,—that although the information contained in the paper had been obtained, by sending to the Isthmus four different corps of engineers, fully provided with instruments for leveling and surveying, and they had made complete plans, and sections of the route, yet that a more extended survey might suggest the superiority of selecting some other affluent of the Atrato, and some other terminus on the Pacific. His principal object had been to show, the practicability of communication between the two oceans, by the valley of the Atrato, and that it possessed peculiar advantages for rendering that communication as large and open as the present wants of commerce imperatively required. If such was the case, he thought that it was worthy of an official survey, and thorough examination, by the Governments of the great commercial nations of the world.

April 29, 1856. The entire evening was devoted to the discussion upon Mr. F. M. Kelley's paper.

It was admitted that a correct description had been given of the routes hitherto proposed, and of the valley in question; but that the route by Panama would be found the most economical and most convenient, if the communication was made between the River Chagres and the Rio Grande, where there were only 15 or 16 miles from tide to tide, instead of by Chorrera, as proposed by M. Napoléon Garrella.

It was objected that Mr. Trautwine, when starting on his expedition, was not supplied with proper instruments for taking a correct survey, and, therefore, that his account could not be implicitly relied on;—that Captain Kennish, on his return to Carthagena, was also in possession of but imperfect levels, and that if the height of the junction of the Truando with the Atrato, was not absolutely correct, it would invalidate all the calculations of the work to be performed. But even assuming the figures and levels of the author, it would hardly be possible to execute works of such gigantic proportions without a great sacrifice of life. It was true

that Chagres and Greytown were the two most unhealthy places in Central America (and, perhaps, even in the world, 400 out of 600 of the Irish workmen employed on the Panama Railway having died in three years, and H. M. S. *Rosamond* having lost more men in six months, off Greytown, than during a three years' station on the West Coast of Africa); but the valley of the Atrato was also very unhealthy, as was evidenced by the state in which Captain Kennish returned, after his exploration. If the necessity for a tunnel was granted, then other places might be found more advantageous for inter-oceanic communication, and Darien presented greater facilities.

Another objection to the proposed route, was the great length of the canal, entailing the employment of steam tugs, which would be found more expensive than trans-shipment by the Panama Railroad. Particulars were given of the height of the range of mountains running through Central America, more especially opposite Port Escosces: the summit level was stated to vary between 950 and 1150 ft., and the apex of the ridge, or backbone. of the Andes, to be so narrow as not to allow of more than five men walking abreast, even supposing it to be cleared of trees. But the chain of the Andes had not been sufficiently examined, to ascertain whether or not it was unbroken between the Napipi, where the depression was found to be 300 or 400 ft., and the Panama Railroad, of which the summit level was only 250 feet. This was a most desirable point to be assured of, before coming to any determination upon the best route; and it was also of great importance that the coast on both sides should be accurately surveyed, to fix upon good harbors, for it was next to impossible to create them; the maps and charts at present in use were not to be relied on. It was doubted, also, whether the traffic would ever repay the cost, for the route from England to Calcutta, or Hong Kong, was actually 600 miles longer by Panama, than by Cape Horn; although it was, of course, admitted, that the former route had the advantage of calmer seas, and of the absence of wind, and that this was no argument against the American trade justifying such an expenditure.

The results of observations with the mountain barometer, were also given, showing that its variations constituted a regular tide, by a knowledge of which calculations could be based with sufficient accuracy, for preliminary surveys, as they would never vary more than 10 ft. from those obtained by sections run with instruments.

It was contended on the other hand, that Mr. Trautwine, Mr. Lane, Mr. Porter, and Captain Kennish, had all been furnished with proper instruments, and that the spirit level had been used for the survey of the whole length of the Atrato, and from the Pacific on the west, over the summit of the Andes, down to the river Truando on the eastern side,—that Captain Kennish was thoroughly qualified for the task he had undertaken; and that the five different surveys, which had been undertaken at different times, and by different persons, all agreed in their results. It was admitted that the whole of Central America was very unhealthy; but it was stated that the proposed route was less so than the Isthmus proper. It was submitted that these were not the questions at issue, but whether a practicable route could be made between the two

oceans by the valley of the Atrato, and whether sufficient evidence had been shown to authorize an official survey.

A letter was read, addressed by Baron Von Humboldt, to Mr. Kelley, (after examining the maps and plans,) expressing great confidence in the survey made and levels taken by Mr. Kennish, and his predecessors. The large number of maps and sections taken on so large a scale furnished all the elements necessary for forming an opinion of a possibility of a communication through the mouths of the Atrato, by the Truando, and by a canal to the Pacific. The failure of the expedition in 1852, and subsequently, for exploring the mountainous country between the Gulf of San Miguel and Caledonia Bay, might be ascribed to the want of such plans.

Humboldt expressed an opinion that a free and open discussion would demonstrate the relative advantages and disadvantages of each proposed locality, and there would really be little difficulty in tracing the proper route, wherever there were good plans and sections, such as had been made under Mr. Kelley's directions, of the valley of the Atrato; his opinion in favor of that route, as compared with all the others, had always been strongly expressed; and in his works, he had even given all the details he had collected relative to the small canal stated to have been made in the year 1778 by the Indians, under the direction of a monk, the Cure of Novita, in order to unite the waters of the river Raspadura with those of the river San Juan, and thus establish a water communication for canoes across the Isthmus. He alluded also to the labors of Captain Fitzroy, R. N., who had in his report, on the Isthmus of Central America, descanted on all the known routes; and he recalled the statement of Lieutenant Wood, R. N., when surveying the coast, to the effect that he traveled on foot, with native guides, from Cupica to the Napipi, in which he bathed, and returned to his ship within six hours, and that the most elevated ground passed over, did not exceed 300 or 400 feet. In fact, Humboldt looked upon the proposition of forming an inter-oceanic canal, by the valley of the Atrato, as perfectly feasible; and he even added, "without locks, or, if possible, without tunnels."

It was due to Mr. Kelley to state, that he did not appear as the agent of any other persons; but that he had caused these various surveys to be made solely at his own cost, and that he had already expended large sums, for the prosecution of these investigations which were carried on under his direct suggestions. In further explanation of Mr. Kelley's views, it was stated that originally he had been favorable to the route by the Atrato and the Raspadura, but subsequently, he became convinced that the route by the river Truando, to Humboldt Bay, would be preferable. He had, therefore, instructed Mr. Kennish and Mr. Lane, to survey that part of the country, and the result had been that the latter route was the one that he at present recommended. He was, however, by no means, prejudiced in favor of any one particular route. His anxiety was, that very accurate and extensive surveys of these districts should be made, under the auspices of the Governments of Great Britain, France, and the United States; and he believed that part of the Isthmus would be found to present more favorable features than any other. With regard to the river Atrato, it was mentioned that it was only to be

compared in magnitude with the largest of the American rivers, and was known to be navigable for the largest ships as far as beyond the junction with the Napipi. It would, therefore, not require any change below that point, and the nature of the climate was such as to preclude the probability of the supply of water failing at any season. It also drained the whole valley, in which rain fell for nine or ten months in the year; besides which, it received a number of rivers, some of which were of equal size with those of the Truando, the current of which it was proposed to reverse, so as to turn the water of the upper part of the Atrato, into the channel of the Truando, and thence into the Pacific.

Although the mean level of the two oceans was generally agreed to be the same, yet in the northern and narrowest parts of the Bay of Panama the tide rose 20 or 30 ft., whilst at Humboldt Bay, to the south, it did not rise more than 12 ft. The high tide level at this latter point, was, therefore, nearly on a level with the junction of the Truando and the Atrato—so that the current would not be so great as to prevent navigation or to damage the works in the channel, as it had been contended would be the case, if a canal were made across the narrow part of the Isthmus where the lift of the tide was greater.

In concluding the discussion, it was stated that the Institution was very much indebted to Mr. Kelley for the paper he had brought forward. It gave a clearer insight than any of its predecessors, into the difficulties of the whole problem of an inter-oceanic canal, and it suggested a route which possessed greater facilities than any other that had been proposed. The English, French, and United States' Governments, entertained enlightened and enlarged views on the subject, and it was believed, that at the proper moment they would lend their strenuous aid in furtherance of this great question, so important to the commercial and political interest of the world.

AMERICAN PATENTS.

List of American Patents which issued from June 3d, to June 24th, 1856, (inclusive,) with Exemplifications.

JUNE 3.

1. For an *Improvement in Uterine Supporters;* William Alley, Columbus, Georgia.

   Claim.—"The circular rings, perpendicular springs, and the hinges to the rings."

2. For an *Improvement in Gas Burning Lamps;* Solomon Andrews, Perth Amboy, New Jersey.

   Claim.—"The wick tube, surrounded by an outer tube or cylinder."

3. For an *Improvement in Marble Sawing Machines;* Josiah Ashenfelder, Philadelphia, Pennsylvania.

   Claim.—"Operating the saws by means of pins and shaft, attached to the drums, in combination with connecting rods and slotted guide bars."

4. For an *Improvement in Feeding Apparatus for Gas Retorts;* N. Aubin, Albany, New York.

   Claim.—"The vessel to contain the materials from which the gas is to be made, in combination with the inner vessel or weight, arranged so as to gradually expel the contents of the vessel as they are melted or rendered more fluid by the heat of the retort,

and thereby afford a regular supply of said materials, to the gas-making process going on in the retort."

5. For an *Improved Method of Regulating Wind Mills;* Jesse Battey, Honeoye Falls, New York.

Claim.—"The regulator, either with a perpendicular or inclined wing, or with the shaft standing upright, and the wing turning horizontally, and its combination with the regulator. Also, the rotary vane and its arrangement, and the connexion of the combined regulators, or either of them separately therewith, for the purpose of securing uniformity of speed. And, lastly, the entire arrangement for starting and stopping the mill."

6. For an *Improved Piano-Forte Action;* Joseph Becker, City of New York.

Claim.—"The double broken action—the part or parts being combined and acting together, completing the whole arrangement of the double broken arrangement."

7. For an *Improvement in Relieving Side-Valves from the Pressure of Steam;* Wm. Burdon, Brooklyn, New York.

Claim.—"The employment of a hollow cylinder, with a closed head, supported upon wheels to run back and forth on the valve seat, or on ways parallel thereto, and receiving a piston attached rigidly to the valve, and thereby being caused to travel with the valve and relieve it of all pressure of steam, beyond what is necessary to confine the valve to its seat."

8. For an *Improvement in Window Frames;* John Casey, City of New York.

Claim.—"Having the portion of one of the stiles of the casing provided with curved slots at its upper and lower ends, and having lugs which are attached to the stile fit in the slots, whereby the part or portion is rendered adjustable."

9. For an *Improvement in Nut Machines;* Richard H. Cole, St. Louis, Missouri.

Claim.—"The arrangement of the round, within an aperture in the angular punch, at the same time that a round punch is arranged within an aperture in the bottom of the nut-box, when the said round punches are combined with movements which cause them to act jointly in perforating holes in the nuts formed in said nut-box. Also, the arrangement of the angular punch and its interior round punch, with the bottom of the nut-box, and the interior round punch; when the said bottom of the nut-box is combined with a spring or its equivalents, in such a manner in relation to the said angular punch, and the round punches, that the action of the said parts in forming a nut, will cause the completed nut to be thicker than the bar from which the blank was cut."

10. For an *Improved Device and Walls of Buildings for Preventing Damage to Goods in case of Fires;* Thomas Estlack, Philadelphia, Pennsylvania.

Claim.—"The combination of the receiver in the masonry of the wall, with the chute, extending over and into the receiver, secured to the floor to be relieved, and altogether detached from the aforesaid receiver."

11. For an *Improved Machine for Polishing Metallic Nuts;* Richard H. and John C. Cole, St. Louis, Missouri.

Claim.—"The arrangement of the planing wheel, the nut-carrying endless-chain, with the partially inclined and partly horizontal groove—the sustaining plates and the edge guiding plates."

12. For an *Improvement in Rotary Brick Machines;* George Crangle, Philadelphia, Pennsylvania.

Claim.—"The apparatus for rotating and stopping the cylinders of rotary brick machines; the said apparatus consisting of the armed disk, the branched lever, the bent lever pawl, and the rachet wheels."

13. For an *Improvement in Needles for Knitting Machines;* Rufus Ellis, Boston, Mass.

Claim.—"Making the journals or connecting rod of the hinge, fast to the male or entering projection thereof, in combination with so constructing the female socket of the hinge, as to enable the male part or its journals, to be moved downwards and laterally, in order to detach the same from the female part, with a spring stop or its equivalent, whereby, when the male and female parts of the hinge of two links are connected together, they may be prevented from accidental disengagement."

14. For an *Improved Saw-Set;* Benjamin Gilpatrick, Lowell, Mass.

Claim.—"The pedestal, the screw attached thereto, and the check-nut and truncated cone or their mechanical equivalents."

15. For an *Improvement in Machines for Felting Hat Bodies;* Sylvester H. Gray, Bridgeport, Connecticut.

Claim.—"The manner in which the compound, continuous, and vibratory motion is imparted to the endless bed."

16. For an *Improvement in Gas Consuming Furnaces;* Jacob Green, Philadelphia, Pennsylvania.

Claim.—"The mode of regulating the admission of air to furnaces, so that each admission shall be controlled by the furnace itself, by means of lever and valve, in connexion with the rod and valve."

17. For an *Improvement in the arrangement of a Gas Retort Bench;* John G. Hock, Newark, New Jersey.

Claim.—"The arrangement of the flues, by which the flame and heated products of combustion are caused to pass, first, under the bottom retorts; next, under the top retort; then, under the retorts, and finally over."

18. For a *Copying Press;* Christian Knauer, Pittsburgh, Pennsylvania.

Claim.—"Adjusting the plates of a copying press to suit the different sized books, by means of a regulating cam, which carries the top plate—so arranged that it shall be the bearing of the pressure cam—either directly or by the intervention of the piston piece."

19. For an *Improved Sawing Machine;* Wm. D. Lavitt, Cincinnati, Ohio.

Claim.—"The arrangement of devices, when combined with the mechanism for setting the saw forward in its own plane."

20. For an *Improvement in Harvester Frames;* Henry F. Mann, Westville, Indiana.

Claim.—"Inclining the rear portions of the side pieces, so that the shaft may lie upon and have the same dip with the one on which it is supported, for the double purpose of giving said shaft a firm support, and to bring its drive-wheel close down to the pinion on the crank shaft."

21. For an *Improvement in Melodeons;* Wm. H. Manning, Rockport, Mass.

Claim.—"The reed box, with the perpendicular valves."

22. For an *Improved Marble Sawing Machine;* Robert Myers, Factory Point, Vt.

Claim.—"The arrangement of the shafts, relative to the driving shaft and to each other, in combination with the saws and varying pitmans, for effecting the simultaneous cutting of three or more taper blocks, at a single operation."

23. For an *Improvement in Wool Carding Machines;* Foster Nowell, Lowell, Mass.

Claim.—"The use, in carding machines, of two surfaces, for conducting and rubbing the sliver from the ring doffers—one of which is cylindrical, and of permanent form; and the other, a belt or apron of flexible material, and capable of adjusting itself to the shape of the cylindrical rubber and the sliver or roving between itself and the cylindrical rubber."

24. For an *Improvement in Making Nuts;* Richard H. Cole, St. Louis, Missouri.

Claim.—"Forcing a portion or the whole of the metal, displaced in forming the holes in the nuts, into the bodies of the nuts; by which I am enabled to make the nuts thicker and more compact than the bar from which they are cut."

25. For an *Improvement in Glass Furnaces;* Samuel Richards, Philadelphia, Penna.

Claim.—"1st, The preparatory deposit of the batch in the cone of an ordinary glass furnace, for utilizing the waste heat. 2d, The car, arranged and used in combination with side shelves. 3d, The movable spout, for conveying the heated batch from the heating shelves into the crucibles."

26. For an *Improvement in Melodeons;* Josiah A. Rollins, Buffalo, New York.

Claim.—"1st, The extension of the wind receiver, towards the back and front of the case, by forming cavities between the frame and the tube board; thereby obtaining room

under the tube board, for the operation of two sets of valves—one behind the other—to operate on four sets of reeds, without increasing the usual size of the case. 2d, The arrangement of the two sets of valves, to bring their movable ends together, and the fitting of the two ends together, so that by the depression of the valves of one set to open them, the corresponding valves of the other set are depressed and opened—thereby effecting the opening of the two sets of valves, by a single set of push-down pins and the keys of ordinary construction. 3d, Supporting the front set of valves at their hinges, by a strip of wood or other material."

27. For an *Improvement in Sewing Machines for Binding Hats;* Isaac M. Singer, City of New York.

Claim.—"The method of turning the hat by the action of the spring or its equivalent, in combination with the feed-motion acting on the rim, and the gauge, against which the edge of the rim bears. Also, the mode of regulating the tension of the binding and smoothing out the plaits and kinks, by passing it around the several folds of a spring."

28. For an *Improvement in Elastic Bottoms for Chairs and other articles;* Lysander Spooner, Boston, Massachusetts.

Claim.—"In the construction of an elastic rest or support, I claim the employment of a series of elastic coils."

29. For an *Improved Boring Machine;* William Samuels and George L. Stansbury, Jackson, Indiana.

Claim.—"The power boring machine."

30. For an *Improvement in Cooking Stoves;* William B. Treadwell, Albany, N. Y.

Claim.—"Connecting the flue in front of the oven with the exit pipe, by means of a tubular flue or flues at top, and forming part of the top of the oven, in combination with the plate which forms the residue of the top of the oven."

31. For an *Improved Marble Sawing Machine;* John A. Toll, Sugar Ridge, Ohio.

Claim.—"The combination of saw gates, adjustable fenders and pair of actuating rollers, having simultaneous vibration, the rollers being secured in bearings in the top of the rockers, so as to permit of being easily removed when it is desired to take out or replace a gate."

32. For an *Improvement in Operating Valves for Steam Engines;* Otis Tufts, Boston, Massachusetts.

Claim.—"1st, The oscillating plate with its attachments, carrying the adjustable cut-off cams acting with their sliding rolls for cutting off the steam variably. 2d, The self-adjusting arrester, and its parts acting on the closing edge of the adjustable cut-off cam, for easing off the motion of the cut-off valve and its gear. 3d, The adjustable arrangement in combination of the cut-off and exhaust cams, to work the cut-off and exhaust valves united. 4th, The double arm, with its sliding and other roll acting alternately on the cut-off and exhaust cams. 5th, The gear joint connexion, between the regulator shaft and the adjusting screw, for working them together, while one is fixed and the other oscillates. 6th, The sliding carrier, with its attachments and friction held nut, for adjusting the variable cut-off cams on the oscillating plate by the regulator. 7th, The arrangement of the adjustable coil springs, in combination with their shaft and lever for forcing the rolls to the cams."

33. For an *Improved Sawing Machine;* Henry S. Vrooman, Logansport, Indiana.

Claim.—"1st, The combination of the frame and sashes when connected and arranged as shown, so that the sashes and frame may be turned within or upon the frames, and thereby allow the saws to be operated in oblique positions. 2d, The employment or use of two patterns, when said patterns are so arranged or connected with the frames and saw sashes, that one pattern will give the saw its lateral movement, and also turn the saw in the sashes, so that their teeth will face the intended direction of the cubs or kerfs, while the other pattern will move the saw when necessary, more or less obliquely, to give the winding or beveled side to the work or stuff."

34. For an *Improved Filter;* Chapman Warner, Green Point, New York.

Claim.—"1st, Constructing the cistern, vessel, or reservoir, with an inner well or vessel, the lower part of which projects below the bottom of the cistern or vessel, and is

provided with any other proper filtering material; the lower part of the vessel, by a tube, provided with a gate or valve, and a suction tube, also communicating with the lower part of the well or vessel. 2d, The flanch, attached to the inner side of the well or vessel, between the layers of charcoal and sand."

35. For an *Improvement in Gas Regulators;* Marshall Wheeler, Honesdale, Penna.

Claim.—"The combination of the gasometer and its goose neck, with the fluid receptacle, and with the graduated lever, and the weighing poise."

36. For an *Improvement in Grain and Grass Harvesters;* Allen B. Wilson, Waterbury, Connecticut.

Claim.—"The elastic strips, fitted in the fingers."

37. For an *Improved Method of Attaching Stem to a Conical Valve;* Henry R. Worthington, Brooklyn, New York.

Claim.—"The use of the hollow conical plug, with the apparatus for opening and closing the same, attached at the bottom of said plug."

38. For an *Improved Lock;* Linus Yale, Jr., Newport, New York.

Claim.—"1st, The peculiar form of the tumbler or an equivalent form, in combination with a changable key. 2d, The rib or wing."

39. For an *Improvement in Fire Arms;* Frederick B. E. Beaumont, Upper Woodhall, Barnsley, England; patented in England, Feb. 20th, 1855.

Claim.—"When the hammer has a mechanism by which said hammer may be set to cock by a direct pull upon it, and when the trigger, hammer, and rotary series of barrels are so combined, that by a backward pull on the trigger, the hammer shall be elevated, the series of barrels turned, and the hammer set free or discharged. I claim combining with the hammer and trigger, a mechanism, (viz: the hooks and slot or their mechanical equivalent or equivalents,) whereby the trigger shall be drawn backward, and the series of barrels turned while the hammer is being drawn back by a direct pull on it."

40. For an *Improvement in Washing Machines;* Solon Bishop, Homer, New York.

Claim.—"The use of the yoke in combination with the spindle and uprights, for giving steadiness to the disk."

41. For an *Improvement in Washing Machines;* John T. Bever, Haynesville, Missouri.

Claim.—"The lever, stem and rubber, when used in combination with the arm, cord, and spring, for producing a vertical and partial rotary movement of said rubber."

42. For an *Improvement in Hand Corn Planters;* Samuel L. Denney, Penningtonville, Pennsylvania.

Claim.—"The combination of the planting cylinder, the pistons, and the funnel."

43. For an *Improvement in Elastic Bearings for Railroad Chairs;* David L. Davis, Dedham, Massachusetts.

Claim.—"Covering the india rubber or other elastic substance with the metallic cap, constructed and applied to the chair, so as to be independent of the control of the spikes which secure the chair to the sleeper, that the plate may be left free to vibrate in a vertical direction and independent of the chair."

44. For an *Improved Amalgamator;* James W. Evans, City of New York.

Claim.—"The use of the rake in combination with the rocker, whereby a compound agitating motion is obtained."

45. For an *Improvement in Railroad Car Brakes;* Mahlon S. Frost, Detroit, Mich.

Claim.—"The arrangement of the sliding blocks at the ends of the car platforms, for engaging and operating simultaneously a set of through bumper and traction rods for applying the brakes, the said sliding blocks being under the control of the engineer, and capable of acting upon both sets of rods or either separately as may be desired."

46. For an *Improvement in Self-registering Ships' Compasses;* R. H. Beverly, Chelsea, Massachusetts.

Claim.—"Registering permanently and automatically the ship courses, on a continuous strip of paper or other material, at known or fixed intervals of time, for a part or

the whole of a voyage, by means of the continuous clock-feed to the fillet or strips, in combination with the ships' compass and marker."

47. For an *Improvement in Sub-soil Ploughs;* Cyrus Garrett and Thomas Cottman, Cincinnati, Ohio.

Claim.—"The arrangement of the standard, flanch, share and mould board, and these arranged with the brace bar and stay bar."

48. For an *Improvement in Paralactic Instruments for Measuring Distances;* Horace L. Hervey, Quincy, Illinois.

Claim.—"Combining the traversing or sliding telescope with the fixed one, in such a manner as to measure distances, by means of a constant angle between them and a variable base."

49. For an *Improvement in Fire Arms;* George Kesling, Lebanon, Ohio.

Claim.—"The constructing of a gun or fire arm, for firing a succession of shots, thus forming a new article of manufacture, superior to any now in use."

50. For an *Improved Apparatus for Rolling and Handling Barrels, &c.;* Servetus Longley, Cincinnati, Ohio.

Claim.—"The levers, in combination with the spring, chain, and cam attachment, clutches, working freely upon wrists and the handle."

51. For an *Improvement in Washing Machines;* John M'Chesney, Louisville, Ky.

Claim.—"The adjustable suspension of the rubber disk by cords, ratchet and pawl, in combination with the rotary, radial, and fluted frustrums of cones in the rubbing face of said disk."

52. For an *Improvement in Revolving Last Holders;* Josiah Mumford, Clarksburgh, Ohio.

Claim.—"The so arranging of the two arms carrying each a last, to one revolving plate, having two inclined planes upon it, that both arms shall revolve at once, and when the last on one shall be up, the other shall be down, and *vice versa*, for the purpose of bringing one last into convenient position for the operator, and removing the other one entirely out of his way."

53. For an *Improvement in Reaping Machines;* Jacob I. and H. F. Mann, Westville, Indiana.

Claim.—"The combination of the bar or plate H, or of other equivalent device, at the back of the apron, with the strip E beneath the apron, and the bar or plate G upon the finger bar, under which the said strip E, and over which the apron extends, or with other equivalent device."

54. For an *Improvement in Machinery for Raking and Loading Hay;* Joseph Smith, Condit, Ohio.

Claim.—"The spring guard plate, operated by the rake."

55. For an *Improvement in Machines for Husking Corn;* Oren Stoddard, Busti, N. Y.

Claim.—"The two stripping rollers, in combination with the cutting device formed of the gate or frame, with knife attached, and the stationary knife on the platform, the frame being operated, whereby the husks are stripped from the ears, and the ears cut from the stalks. Also, in combination with the stripping rollers and cutting device, the rollers by which the ears are fed or guided into the inclined spout."

56. For an *Improvement in Lattice Bridges;* Lucius E. Truesdell, Warren, Mass.

Claim.—"The braces in combination with the rafters."

57. For *Improved Driving Wheels for Steam Drags or Propellers;* George W. N. Yost, Pittsburgh, Pennsylvania.

Claim.—"1st, The combination of the double angular flanches, with the surface of a driving wheel. 2d, In combination with the flanches, the clearers."

58. For an *Improved Steam Land Propeller;* George W. N. Yost, Pittsburgh, Pa.

Claim.—"The combination and arrangement of a rotary engine, with the driving wheels of a land propeller, by means of the arrangement of cogged gearing."

59. For an *Improved Vise;* Abraham Huffer and Benjamin Fahrney, Washington Co., Maryland.

Claim.—"The use of the sectors, in combination with studs, for the purpose of rendering the jaws of the vise parallel to each other."

60. For an *Improvement in Making Screws;* Cullen Whipple, Assignor to New England Screw Company, Providence, Rhode Island.

Claim.—"The combination of the feeding slot, moving series of discharging grooves, and guard plate."

61. For an *Improved Miter Box;* William P. Wood, Assignor to self, and Samuel De Vaughan, Washington, D. C.

Claim.—"The arms."

62. For an *Improvement in Nail Machines;* Daniel Dodge, Keeseville, New York.

Claim.—"The use of the roller, the anvil, and the hammers, either in combination with the spring or without it."

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63. For an *Improvement in Hand Pegging Machines;* Wm. W. Batchelder, City of New York.

Claim.—"The attachment of the knife to the plunger, and the arrangement of the upper groove in regard to shutting off communication between the trough and the peg receiver. Also, the combination of the vibrating foot piece with the lower end of the machine, operated by means of the wedge and spring."

64. For an *Improved Hydro-Steam Engine;* Wm. Baxter, Newark, New Jersey.

Claim.—"The method of imparting rotary motion to a wheel or wheels, by the pressure of steam or other equivalent, expanding gas acting alternately on the opposite one of two columns of water, or other liquid, connected together to cause the said water, by such alternate action, to pass through and impel the wheel or wheels."

65. For an *Improvement in Harness Trace Couplings,* Charles K. Bradford, Lynn, Massachusetts.

Claim.—"The combination of the india rubber plug or spring friction bearer, with the tenon button and its locking case; the same being made to operate therewith. Also, arranging in the locking case, and transversely of its entering slot, the safety recesses."

66. For an *Improvement in Rotary Pumps;* John Broughton, Chicago, Illinois.

Claim.—"A rotary pump, composed of a rotary eccentric piston, within an oscillating barrel, with any arrangement of inlet and outlet passages."

67. For an *Improvement in Cutting Flour Mill;* Jonathan Burdge, Cincinnati, O.

Claim.—"Forming the surface of the cutter head with central and peripheral ledges, and a plane or level depression between them, equal in width to the cutters, and in depth to the depth of the cut required, for the purpose of easily setting the cutters all to an exact and uniform height, and of preventing the possibility of their being brought into contact with the counter plate above; and, also, for the purpose of preventing the escape of meal or particles of grain at the periphery. Also, the notches or nicks in the ledge of the cutter head, and the notches in the ledge or surface of the counter plate—said notches having the least possible width at their inner ends, and gradually widening or flaring outwards, when the two sets are arranged in combination, so as to cross each other, and thus mutually escape outward by their edges, any dust or glutinous substance, which may have a tendency to adhere to the opposite surfaces of the ledges. Also, the peculiar construction and arrangement of the counter plate, with bent, gathering and stationary ridges, running across from the inner to the outer peripheries of a conical concavity in its under side—the lower edges of said ridges being all in the same plane, and even with the surrounding surface, when combined with the cutters, and operating in combination therewith."

68. For an *Improved Machine for Manufacturing Reed Boards for Melodeons;* Jeremiah Carhart, City of New York.

Claim.—"1st, The means whereby the reciprocating motion, with variable stroke,

is communicated to the frame, viz: the segment which gears into the rack on the frame, and into the pinion on the shaft; the pulleys on the shaft, and the shaft in the frame actuated by the bar, and the bars on the frame, by which the pulleys are alternately connected and disconnected with the shaft. 2d, The dogs. 3d, Giving the lateral feed-motion to the frame, by means of the rack and pawl, when said pawl is actuated by the bars and rollers."

69. For an *Improved Method of Operating Head Blocks of Saw Mills;* John M. Carlisle, Williamston Springs, S. C.

Claim.—"Attaching or connecting the carriage to an endless chain or belt, by means of an arm, so that it will actuate at each end of the stroke of the carriage a slide having a pawl attached—which, by means of suitable gearing moves or sets the log to the saw—whereby the movement of the carriage, and also the setting movement of the log, are rendered automatic or self-acting."

70. For *Improved Water Proof Percussion Caps;* James Chattaway, Hamden County, Massachusetts.

Claim.—"The application to percussion caps, of a fusible alloy, which will melt without exploding the powder; using for that purpose the metallic compound, or any other substantially the same."

71. For an *Improvement in Steam Pressure Gauges;* Samuel W. Brown, Lowell, Massachusetts.

Claim.—"The combination of the rigid radial arms, with the flexible and elastic disk or surface, for covering the joints of these radial arms steam-tight—when yielding or moving, by the force of steam or water, to correctly indicate the pressure thereof—the radial arms being fitted so as to operate so close to each other as to prevent the surface from bagging.

72. For an *Improved Shuttle Operator;* Hiram Collin, Salisbury, Mass.

Claim.—"Opening and closing the blind or shutter, by means of the inclined or oblique rod, which passes through the stiles of the casing, and having its lower or outer end bent and fitted within a socket attached to the lower part of the shutter or blind: the rod or blind, being secured at desired points by means of the pin in the knob."

73. For a *Machine for Coating Cloth with Paint;* Daniel Cushing Wheeling, Va.

Claim.—"The arrangement of the several rollers and belts, wherein I make use of the friction of the cloth on the roller, for the purpose of giving the necessary tension and movement of said cloth, when in combination with the means of spreading the paint or composition, and in the delivery of the cloth when coated. Also, the arrangement of the hanging frame, for the purpose of receiving the cloth for drying—thereby rendering the painting and hanging it, a single mechanical operation."

74. For a *Machine for Rubbing and Polishing Painted Cloth;* Daniel Cushing, Wheeling, Virginia.

Claim.—"The mechanism, for the purpose of rubbing painted or enameled cloth."

75. For an *Improvement in Cleaning India Rubber;* Austin G. Day, Seymour, Conn.

Claim.—"The exhaustion of the noxious gases from the crude india rubber, and its subsequent treatment, for the purpose of cleansing and purifying it."

76. For an *Improved Pocket-Book;* J. C. Dickinson and Robert Bate, Hudson, Mich.

Claim.—"The plate, with hooks attached; the plate being secured at one side of the pocket-book, and used with or without the sliding plate."

77. For *Improved Shears for Sheet Metal;* Henry C. Dole, Adrian, Michigan.

Claim.—"The employment of pitman, levers, and eccentric wheels, for operating the blades, in combination with the adjustable gauge."

78. For an *Improved Method for Effecting Uniform Pressure upon the Pumping Piston of Double-acting Steam Pumps;* Robert B. Gorsuch, City of New York.

Claim.—"The secondary piston, in combination with pump cylinder—depending for its action upon the elastic balance chamber, and the reverse motion of the pump plunger combined, or either separately, for attaining the end in view."

79. For an *Improvement in Three-Wheeled Carriages for Children;* John H. Gould, City of New York.

Claim.—"The curved arms, resting upon the arms or bars, forming a support for the body of the carriage, and terminating in sockets, both in front and back, for the reception of the arms of the frame, for the purpose of permitting the carriage to be drawn and pushed from either the back or front position."

80. For an *Improved Tool for Watch-makers;* Wm. Hart, Mayville, Wisconsin.

Claim.—"Having the jaw attached to the upper part of the leg of the callipers and the jaw—connected to the upper part of the leg by links—the jaw having a shank attached to it, the shank passing through a slot in the leg, and bearing against a spring; and the shank having a rod attached to it—which rod passes through a hollow screw which is attached to the jaw—the screw having a nut upon it."

81. For an *Improvement in Thrashing Machines;* Wm. Holmes, Brooklyn, N. Y.

Claim.—"The use of a series of cams, for the purpose of operating the beating levers, by revolving in the curves, and striking both arms of each of the levers in rapid succession, giving to the downward motion of the longer arm or beater, a quick, whipping stroke."

82. For an *Improvement in Feed Apparatus for working Gutta-percha;* James Reynolds, City of New York.

Claim.—"The combination of the rotary forcing apparatus, consisting of a cam for forcing out the sliding pistons, arranged entirely within the rotating head, with a passage or passages within the rotating head, which carries the said pistons, providing for leakage."

83. For an *Improvement in Hermetically Sealing Preserve Cans;* Charles E. Russell, St. Louis, Missouri.

Claim.—"The combination of the spring ring and groove."

84. For an *Improved Method of Applying Horse Power to Fire Engines;* David Russell, Lockport, New York.

Claim.—"The arrangement of the series of pumps, with the circular tram way, and the mechanical devices actuating the pistons."

85. For an *Improvement in Safes for Ships and other Vessels;* Wm. Mount Storm, City of New York.

Claim.—"1st, The combination of the receptacle or "sheath"—open at the bottom, and at its top open to the upper deck, with the (independently water-tight) double shelled buoy—having within it, the independently water-tight "deposit chamber" for valuables, said chamber being accessible from the exterior by a water-tight door, closing and clamping for that purpose on an elastic seating, &c. 2d, The buoy, the tube, flag, and float."

86. For an *Improved Machine for Sticking Pins;* J. B. Terry, Hartford, Conn.

Claim.—"1st, The movable conductor or conductors, with notches for the head to hold the pins, and push them into the crimp portion of the paper. 2d, The movable notched cross-bar, to correspond with the notches in the conductors, and the movable plate, or its equivalent, to hold the pins in their proper place, while the pins are thrust to their place by the conductor. 3d, The combination of the movable conductor or conductors, the apparatus for changing the position of the points of the pins, and holding the same with the clamp or jaws, which hold the paper while the pins are thrust through."

87. For an *Improvement in Constructing Railway Car Wheels;* Wm. R. Thomson, Cleveland, Ohio.

Claim.—"Having the butts made the entire length of the hub, and the sides of the butts inclined—caused or made in zig-zag form—so that they form, when placed together, dove-tail joints, for the purpose of preventing any lateral movement of the butts, and to ensure the perfect welding of the same, at all points of contact, whereby a solid and perfect hub is obtained."

88. For an *Improvement in Registers and Ventilators;* Edward A. Tuttle, Williamsburgh, New York.

Claim.—"The combination of the leaves or valves, and the centre-piece, connected together in working order at the points."

89. For an *Improved Bolt for Shutters;* Philip Warner, Lancaster, Pennsylvania.

Claim.—"Two corresponding silver plated metal flanched plates, in combination with a silver plated knob, attached to an inside bolt, having on the reverse or inside of the plates, corresponding clips, in which the bolt operates—said bolt and clips to be fitted to a mortise in a window shutter, for the purpose of presenting a neat silver plate on each shutter, to hide the bolt, and completely protect it from the weather."

90. For an *Improvement in Governor for Steam Engines;* Marshal Wheeler, Honesdale, Pennsylvania.

Claim.—"The pressure piston, working in an off-set chamber, placed between the throttle and the engine cylinder, and combined with the throttle valve; said pressure piston being made to act against a spring, which simultaneously closes it and the throttle valve, and which yields in proportion to the resistance upon the engine piston, and opens the throttle valve in a corresponding degree."

91. For an *Improvement in Reaping and Mowing Machines;* George W. N. Yost, Pittsburgh, Pennsylvania.

Claim.—"The operating mechanism, or its equivalent, to produce an abrupt and intermittent reciprocating motion, in combination with the inclined edged cutters, and the straight edged cutters, whereby I obtain the shear and chop blow."

92. For an *Improvement in Carriages;* Reuben W. Benedict, Briant, New York.

Claim.—"The combination of the springs with the springs and concomitant parts in such a manner that the torsional motion of the body shall affect the spring."

93. For an *Improved Apparatus for Cutting the Strings that secure Corks in Bottles;* George Blanchard, City of New York.

Claim.—"The internal and slanting arrangement of one or more knives inside the cup, the knife or knives being so arranged in the cup, that when the cup is put over the cork and turned, the strings are immediately cut, and the cork safely received in the top of the cup."

94. For an *Improvement in Platform Supporters;* Charles E. Flagg, Sherburne, Mass.

Claim.—"The improved platform supporter or combination of the fastening bar, the slide bar, the bearer, and the strut, as applied together."

95. For an *Improvement in Potato Diggers;* Amos L. Grinel and John Z. Williams, Willet, Wisconsin.

Claim.—"The two rakes attached to the frames, the frames being hung on the shaft, which is connected to the frame."

96. For an *Improvement in Seed Planters;* Plymon B. Green, Chicago, and Edward A. Kennedy, Newark, Illinois.

Claim.—"The seed slide, in combination with the foot, side springs, and catchers."

97. For an *Improved Rotary Excavator;* Daniel Judd, Hinsdale, New York.

Claim.—"The cylindrical form of the excavator, so formed, in combination with the wheels, windlass, and frame, that the load bears on its centre, and rotates when being raised, and also when being discharged."

98. For an *Improvement in the Mode of Attaching Horses to Shafts of Vehicles;* Geo. B. Kaighn, Lumberton, New York.

Claim.—"Supporting and controlling the ends of vehicle shafts, by means of the loops or tugs secured to the hames, making the breeching (consisting of the band, the adjustable holders, or their equivalents,) a permanent and adjustable part of the said shafts; and attaching the back ends of the traces together at the back end of the said shafts, so as to bear against and move on the pulleys in accordance with the forward motions of the horse; the whole being arranged and operating together substantially as described and set forth, and for the purpose of dispensing with the usual saddle, belly bands, crupper, breech supporting straps, and whiffle tree, and thus facilitating in connecting and disconnecting horses and vehicles."

99. For an *Improvement in Seeding Machines;* C. O. Luce, Freeport, Illinois.

Claim.—"The distributing wheels, in combination with the slides or valves."

100. For an *Improvement in Corn Shellers;* Ebenezer Morrison, Franklin, N. H.

Claim.—"The arrangement of the two toothed truncated feed cones, for both revolving and feeding down the ears of corn, in such a manner that the toothed shelling wheel will remove all the corn from the cob during such revolving."

101. For an *Improvement in Seed Planters;* George A. Meacham, City of New York.

Claim.—"1st, A machine for planting corn, constructed so as to be applied to, and operated by the foot. 2d, The employment of self-adjusting step, applied in connexion with the plunger and slide seed tube or box, and flexible seed conductor."

102. For an *Improvement in Machines for Stuffing Horse Collars;* H. G. Robertson, Greenville, Tennessee.

Claim.—"In combination with, and specified relation to, the movement of the reciprocating plunger or stuffing rod, the intermittently reciprocating mechanical feed, formed by the bearded racks or toothed slide and retaining fingers, operating together simultaneously in reverse directions within the hopper."

103. For an *Improvement in Straw Cutters;* Thomas Wiles, Somerset, Ohio.

Claim.—"The feed and discharge bottom, in combination with the reciprocating knife projection."

104. For *Improved Breech Loading Fire Arms;* Henry G oss, Tiffin, Ohio.

Claim.—"The breech piece and eccentric lever working together, in combination with the breech seat, to which the axis of the breech is normal at the time of discharging, whereby the pin, around which the breech turns, is relieved, and loosening from recoil prevented."

105. For an *Improved Sabot for Rotating Shot and Shell;* W. W. Hubbell, Philadelphia, Pennsylvania.

Claim.—"The construction of wooden sabot, adapted to relieve the friction of, and easily rotate the smooth spherical shot or shell of the common diameter, consequent weight, form and extent of windage, and bearing of its weight on the bore out of its equal size of smooth bored cannon under the conditions as described."

106. For an *Improvement in Bedsteads;* W. Hentress, South Berwick, Maine.

Claim.—"The pins, when placed in the under side near each end of the slats, and interlaced with the cords."

107. For an *Improved Mode of Attaching Pads to Saddle Trees;* James Ives, Mount Cannel, Connecticut.

Claim.—"The peculiar construction of hinge joint, for connecting the pad to the tree."

108. For an *Improved Method of Operating Head Blocks of Sawing Mills;* Joseph Hurtzeman, Lancaster, Ohio.

Claim.—"Connecting the dogs to the shaft by means of the racks and gearing, in combination with the toothed wheel, having the hollow hub or geared rim attached, the wheel being placed loosely on the shaft which is provided with the pawl."

109. For an *Improvement in Wheel-wrights' Machinery;* A. S. Macomber, Bennington, Vermont.

Claim.—"The jaws operated by the screws, worm wheels, and connecting rods, one pair of jaws being attached to an adjustable bar."

110. For an *Improved Die Stock for Cutting Screws;* Patrick M'Glen, Waterford, New York.

Claim.—"The arrangement of one or more dies, within a circular two-way ratchet, which is moved by adjustable pawls."

111. For an *Improved Rotary Shingle Machine;* Jason Palmiter, Jamestown, N. Y.

Claim.—"Placing a series of carriages on the sides or faces of a polygonal wheel, and giving said carriages the proper feed-motion, by means of the racks, pinions, ratchets, and sliding bar with pawls attached, the above parts being arranged in connexion with the circular saw."

112. For an *Improvement in Repairing Circular Saw Teeth;* M. L. Parry, Galveston, Texas.

Claim.—"The stop or mandrel, fitted within an adjustable socket, which is attached to an arm, the arm being secured to the frame."

113. For an *Improvement in Ice Cream Freezers;* Joseph Parresette, Indianapolis, Indiana.

Claim.—"The spiral scraper, in combination with the drop catcher, for the purpose of regulating the movement of the can and scraper, in relation to each other."

114. For an *Improvement in Attaching Teeth to Sickle Bars of Harvesters;* J. C. and L. C. Pluche, Cape Vincent, New York.

Claim.—"Attaching the teeth of the sickle to the bar, by the cleats secured to the back ends of the teeth, the cleats being fitted in a groove in the bar."

115. For an *Improved Mode of Sounding Whistles for Fog Signals;* R. Porter, Washington, D. C.

Claim.—"The combination of vertical cylinders (or their equivalents), and whistles attached thereto, for the purpose of having loud sounds produced by the undulation of the waves or swells."

116. For an *Improvement in Gutta-Percha Tubing;* James Reynolds, City of N. York.

Claim.—"Constructing the mandrel with a joint."

117. For an *Improvement in Casting Bar Wheels;* L. H. Allen, Assignor to self and E. M. Ivens, Tamaqua, Pennsylvania.

Claim.—"Passing a volume of steam through the eye of a cast metal wheel, whilst the periphery is in the chill, whereby the contraction of the wheel as it cools is equalized."

118. For an *Improvement in Repeating Fire Arms;* A. Hall, Assignor to self and J. G. Caldwell, City of New York.

Claim.—"The ring of chambers, having a single spoke extending from its inner periphery to its hub, so that said ring may turn on a centre support, make almost an entire revolution, and pass freely and truly through the mortise in the breech, when its chambers are in succession brought opposite or incline with the box of the gun. Also, so combining the bolt with the ring of chambers, as that it may be detached from its catch, and the ring turned to bring the next chamber in line by the hand which supports the gun, and without changing the hand from its supporting position."

119. For an *Improvement in Japanning Pins;* John J. Howe and Imman Piper, Assignors to the Howe Manufacturing Co., Derby, Connecticut.

Claim.—"Dipping a portion of the length of the pin in the compound, whilst inserted in a sheet of paper, and with one end downward, and then subjecting them to the baking operation, in combination with the second dipping and baking in the reversed direction to japan the remaining portions. Also, controlling the pin during the process, by sticking the pins into the sheet of paper through holes in a plate of metal, or equivalent substance; the said holes being of sufficient size for the free passage of the shanks or barrels of the pins, but not for the heads, so that after the first dipping and baking, by reversing the pins and pulling off the sheet of paper, the pins will hang by their heads for the second dipping and baking."

120. For an *Improved Machine for Sticking Pins;* J. J. Howe and I. Piper, Assignors to the Howe Manufacturing Co., Derby, Connecticut.

Claim.—"In combination with a guide groove or grooves and a follower, the employment of the sliding frame for holding and shifting the sheet of paper, that the pins may be properly spaced and inserted in the sheet of paper, at right angles or nearly so with its surface. Also, in combination with the guide groove or grooves, follower, and holding and shifting frame, the employment of a perforated plate, and interposed between the guide groove or grooves, and the sheet of paper held in the frame, that the pins may be inserted simultaneously in the plate and in the sheet of paper."

121. For an *Improvement in Metal Beams;* J. K. Ingalls, Brooklyn, N. Y., Assignor to M. H. Howell, City of New York.

Claim.—"1st, The corrugated web, when cast with or upon the top flanch, and arranged with the bottom flanch or tie, in such manner as to afford flexibility to the cast portion of the beam, to accommodate its action to the tension of the wrought portion. 2d, The tapering form of the corrugations in their height, with a right line where the web attaches to the top flanch, with which it acts in resisting compression, and which increases the breadth of said corrugations, and, consequently, the flexibility of the web where it touches the bottom flanch or tie, with which it acts in resisting extension."

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122. For an *Improvement in Hand Corn Planters;* George Atkins, Pittsburgh, Pa.

Claim.—"Attaching the plate by a hinge or joint, to the lower part of the box—the plate having a curved plate attached to its inner side, which plate is provided with a hole, and works over the curved portion of the plate, which is attached to the lower end of the box—the straight portion of the plate being fitted and working between plates attached to the plate, so that the distributing device may be operated by merely throwing forward the box."

123. For an *Improved Marble Sawing Machine;* Cyrus Avery, Tunkhannock, Pa.

Claim.—"The combination of the sliding bars, link, lever, with the rack and movable stirrup."

124. For an *Improvement in Machines for Thrashing and Winnowing Grain;* Alfred Belchambers, Ripley, Ohio.

Claim.—"The plates or rubbers, placed in the shoe, when the upper plate or rubber is hung upon a shaft, so that it may vibrate laterally, by the shake motion of the shoe."

125. For an *Improvement in Machines for Counting Coin;* M. F. Bonzano, New Orleans, Lousianna.

Claim.—"The manner of passing the pieces in regular order through a slot, by means of a toothed wheel, for the purpose of making them aid, as a pinion to revolve a wheel, connected by other wheels, with a registering index."

126. For an *Improved Machine for Bending Hay Forks;* Nathan Brand, Leonardsville, New York.

Claim.—"The combination and arrangement of the following devices: consisting of the stationary jaw, provided with a ledge or side projection—the disk, with a score for the shank of the fork; the hinged wings or side levers, operated so as to bend the tines around the jaw; the hinged jaw, so arranged as to give the tines the curve required, and press the shank into the score in the die, and give it the proper position in relation to the tines."

127. For an *Improved Saw-Set;* Lebbeus Brooks, Great Falls, New Hampshire.

Claim.—"Arranging the adjuatable angular bed in the jaw lever, and with respect to the jaw and sliding gauge, applied thereto."

128. For an *Improvement in Safety Valves;* Robert Cornelius, Philadelphia, Pa.

Claim.—"The arrangement of the weight and lever of an ordinary safety-valve, as that, as soon as the steam reaches its limit of pressure, the weight shall so change its position, as to open, and keep open, the aperture of discharge of steam."

129. For an *Improvement in Making Sheets of Leather from Curriers' Shavings or "Buffings;"* Charles F. Crockett, Newark, New Jersey.

Claim.—"Making sheets of leather of any desired size and thickness, of curriers' shavings or buffings, by lapping and cementing them together while in a moist state, and then subjecting the mass to pressure."

130. For an *Improvement in Differential Governor for Marine and other Engines;* Charles N. Clow, Port Byron, New York.

Claim.—"Controlling the throttle valve of the engine, by means of pistons and valves, by producing a vacuum on either side of piston, alternately as the motion of the engine may require."

131. For an *Improvement in Ships' Capstans and Windlasses;* James Emerson, Worcester, Massachusetts.

Claim.—"The double or divided capstan or windlass, arranged for operation, and consisting of an upper hand operative portion of the body or capstan proper, and under loose portion of said body, separately controllable by friction strap or gearing at pleasure, with the upper operative portion of the body of the capstan."

132. For an *Improvement in Locks;* Michael Erb and F. C. Goffin, Newark, N. J.

Claim.—"Placing tumblers across the shaft, viz: the end tumblers placed loosely upon it, with washers between them, whereby, a positive action or movement is given to the tumblers—the use of springs dispensed with, and the lock rendered durable, simple, and economical to manufacture."

133. For an *Improvement in Strapping Tackle Blocks;* J. B. Fayette and D. Wheeler, Oswego, New York.

Claim.—"A strap, made in two parts, each part having a hook at one end to hook into the eye of the block hook, and a hole near the other end for the bolt that fastens them together."

134. For an *Improved Carriage Springs;* John U. Fiester, Winchester, Ohio.

Claim.—"Forming elastic twisted springs, with elliptical curve, for the purpose of giving to the same greater strength and elasticity, and also, a lateral and vertical motion."

135. For an *Improvement in Silver Plate Cake and Fruit Baskets;* R. Gleason, Jr., Dorchester, Massachusetts.

Claim.—"Attaching the two lids or covers to the box of the basket, by the swivel joint hinges—the lids or covers corresponding in form to that of the body—whereby, the lids or covers may be placed over the body, or turned downward, and secured by the catches underneath the body."

136. For an *Improvement in Molasses Pitchers;* Henry W. Goodrich, Boston, Mass.

Claim.—"Arranging the drip receiver, the pipe thereof, and the discharging end of the pipe, with respect to the nose and neck of a pitcher, in order that when the pitcher is being tipped, for the purpose of pouring from its nose, none of its liquid contents may pass into the mouth of the discharge pipe; the drop receiver and its pipe subsequently serving to catch the drippings from the nose, and convey the same back into the pitcher."

137. For an *Improvement in Certain Devices in Planing Machines;* Valentine Houck, Buffalo, New York.

Claim.—"I ask a patent for the improvements, so that I may either construct a machine combining them, or send the improvements to others, to be used upon machines already constructed."

138. For *Improved Mechanism for adjusting Circular Saws obliquely to their Arbors;* George Hutton, City of New York.

Claim.—"The combination of the two spherical faced and peculiarly perforated movable rollers, with the concave fixed collar, and the concave washer. Also, the employment of the adjusting screws, in combination with the collars, the concave fixed collar, and the concave washer."

139. For an *Improvement in Brushes for Cleaning Travelers;* Henry S. Houghton, Blackstone, Massachusetts.

Claim.—"The application of a brush to the delicate movement of the ring traveler, so as to rapidly clean the same, without breaking down the thread."

140. For an *Improvement in Refrigerators;* Samuel Hickok, Buffalo, New York.

Claim.—"Covering the inside box case, or metallic frame, with woolen flannel or other cloth, in such a manner, that the water, as it drips from the melting ice, will drip, on to and saturate the cloth, and from the cloth, will be conducted out of the case—thereby producing a strata of cold water held in the cloth, and the entire surface of the inner metallic frame, and surrounding the articles to be kept cool."

141. For an *Improvement in Machines for Paring Apples;* Horatio Keyes, Leominster, Massachusetts.

Claim.—"Attaching the cutter head to the bar by a pivot, and having a lip or bearing piece on the cutter head."

142. For an *Improved Valve for Double-acting Pumps;* John C. King, Belvidere, New Jersey.

Claim.—"A single-acting pump valve, with two chambered faces, standing at an angle to each other, and operated by the pressure of the water from the pump cylinder, to answer as suction and delivery valve to a double-acting pump."

143. For an *Improvement in Brick Presses;* Lewis Kirk, Reading, Pennsylvania.

Claim.—"The oscillating mould chamber, in combination with the clay guard, concentric with its trunnions, and the piston, actuated by the oscillation of the mould chamber."

144. For an *Improved Door Lock;* Christian Knauer, Birmingham, Assignor to Warwick, Attlebury & Co., Pittsburgh, Pennsylvania.

Claim.—"Actuating the bolt of a right and left hand lock, by means of a tumbler, which has a vertical motion, for the purpose of freeing and securing the bolt; and also, a vibrating motion, for throwing in or out, the tumbler being arranged in relation to the key in such a manner, that the bolt will be thrown out the same distance in whichever way the key may be inserted."

145. For an *Improvement in Ploughs;* N. S. Lockwood and J. D. Winn, Dayton, O.

Claim.—"Welding the post or 'breast' to the mould-board, and attaching the share and land-side to the mould-board and post, or 'breast,' by means of the flanch at the lower end of the post or breast, and the plate of the share and land-side, through which flanch and plates the screw bolts pass."

146. For an *Improvement in Feeders for Roller Cotton Gins;* L. J. Mallard and Wm. S. Baker, Riceboro', Georgia.

Claim.—"The combination of the screen with the revolving toothed cylinder, when so placed in relation to the ginning rollers, that any excessive accumulation of cotton between them shall be removed or prevented, and the excess be retained between the cylinder and screen, until its quantity shall be equalized and relieved by the gin."

147. For an *Improvement in Adjustable Punches for Setting Artificial Teeth;* Samuel Mallett and Augustus B. Smith, New Haven, Connecticut.

Claim.—"The combination of two punches—one immovable, the other movable in the slot, with a spring, and the two cavities—one in the plug or immovable punch, and the other movable, with the movable punch; the latter to be set by the insertion of the wires of the teeth into said cavities, in order to make the distance between the holes in the plate correspond with the distance of the pins in the teeth."

148. For an *Improvement in Odometers and Counting Machines;* Joseph L. Martin, Baltimore, Maryland.

Claim.—"1st, The attachment of a friction clutch to the ratchet-lever, operating against the bar of the connecting rod, for producing the requisite motion in the first wheel—so arranged, that any excess of motion in the bar will not produce excess of motion in the wheel; and I claim this, whether in combination with the ordinary train of wheel work, with a single or double ratchet pawl; or in combination with the arrangement of wheel work. 2d, The combination of the cam, (whose axis is attached directly to the carriage axle,) with the connecting rod and frictional clutch upon the ratchet lever."

149. For an *Improvement in Cartridges;* Edward Maynard, Washington, D. C.

Claim.—"My improved cartridge for breech loading fire arms, composed of a hard metal cylindrical case, charged with powder, and combined with a projectile of such shape, that whether the case receive a large or a small charge of powder the said projectile is self-retained in contact with the powder, in such a position, that its point must be coincident with the axis of said case, and a perfectly tight joint formed between said projectile and case, by filling the grooves in the former with greasy matter."

150. For an *Improvement in Non-elastic Bands for bales of Cotton, and other fibrous substances;* David McComb, Memphis, Tennessee.

Claim.—"The combination of the link or slide with the hooked ends of hoops, for the purpose of securing them from opening with the expansive force of the bale. Also, the peculiar formation of the link, which forms a secure means of keeping the hooked ends of the hoop together, and has a guard which keeps it to its place, is easy of application in putting on, and may be removed at pleasure, without mutilation."

151. For an *Improvement in Smoothing Irons;* Oscar F. Morrill, Boston, Mass.

Claim.—"Attaching to the iron, a vessel or receptacle for containing alcohol, or other spirit, constructed with a spout or chamber, into which the spirit is conducted by a wick, and heated by a flame properly applied thereto—the said spout or chamber having attached to it, and communicating with it, a small tube, through one orifice of which, the gas or vapor thus generated is forced in a jet, and ignited by coming in contact with the flame employed for generating the gas—by which arrangement, a jet of flame is made to impinge upon the hollow chamber of the iron. Also, constructing the iron with a partition at the rear portion of the iron."

152. For an *Improvement in Clutch for Flour Packers;* John T. Noye, Buffalo, N. Y.

Claim.—"The clutch, formed by the hollow shaft, with slots and chamber, in connexion with the round shaft, with driving pins and balance or slide guard, to drive the pins up into the chamber."

153. For an *Improvement in Harvesters;* J. C. and L. C. Pluche, Cape Vincent, N. Y.

Claim.—"The frame, when arranged in respect to the driving shaft, and having the bar attached to its lower end—and the strips attached to the bar—the upper ends of the strips having a roller attached to them, which roller is fitted and works in a guide, the finger bar being connected to a shaft fitted within the bars."

154. For an *Improvement in Auger Handles;* N. C. Sanford, Meriden, Conn.

Claim.—"Fastening the stick or handle in the eye of the auger shank, by means of the screw passing through the eye, handle, and into a recess in the shank, in combination with the clamp or screw-plate on the under side of the stick, within the eye, and operated by the screw."

155. For an *Improvement in Machines for Paring Apples;* John D. Seagrave, Worcester, Massachusetts.

Claim.—"The attaching the spring to the rod, so as to hold or return the knife to nearly right angles to the line of motion, to or from the centre."

156. For an *Improved Port-Folio;* James Shaw, Providence, Rhode Island.

Claim.—"The roller, attached to the covers, provided with the grooves and rings which are fitted in the grooves."

157. For an *Improvement in Corn Harvesters;* W. S. Tilton, Boston, Mass.

Claim.—"The rotating cutters and stationary knife, placed within an adjustable frame."

158. For an *Improved Method of Operating Cutters in their Heads for Irregular Forms;* John Tear, Chicago, Illinois.

Claim.—"The use of a cutter head, in which the knives or cutters are caused to traverse during the rotation of the cylinder, for the purpose of adapting themselves to the shape of the thing to be cut by them."

159. For an *Improvement in Machines for Sizing Hat Bodies;* Joseph Thomas, Brooklyn, New York.

Claim.—"1st, Combining with the wheel, the wheels, (or their mechanical equivalents,) for giving the main wheel a vibrating motion, when used with a stationary plate or bed, in order to rub the goods back and forth; and, also, in combination therewith, the mechanism for giving the main wheel the constantly advancing motion. 2d, Combining and arranging the circular plate or bed and table, in such a manner, that by the levers (or their equivalents,) and cords, the same mechanism may adjust the plate to the wheel, and also the table to the ratchet rollers—and thus give any pressure desired to the goods."

160. For an *Improvement in Coal Heating Bakers;* Jesse D. Wheelock, Mayville, Wisconsin.

Claim.—"The use of the descending flue or tube, in two parts—the one sliding into the other, so that the same can be lengthened or shortened at pleasure for the purpose of passing off the fumes and smoke of the coal burned in the chamber, in combination with the said chamber, and the perforated bottom for baking purposes."

161. For an *Improvement in Water Heaters surrounding Fire-pots of Cooking Apparatus;* Edward Whitely, Boston, Mass.

Claim.—"1st, The diagonal partition between the pipes. 2d, The inclined roof of the heater, for the purpose of expelling the air therefrom."

162. For an *Improvement in Revolving Harrows;* Garret J. Olendorf, Middlefield, New York.

Claim.—"The construction and combination of the several parts of my revolving harrow."

163. For an *Improvement in Pre-Tanning Compositions;* Israel P. Williams, Salem, Massachusetts.

Claim.—"Subjecting the hides, after the "lining" and "drenching" of them, pre-

paratory to their being immersed in the tanning liquor, to the action of a bath of the carbonate of soda and nitre, and one of an acid solution or mixture."

164. For an *Improvement in Saponifying Fats;* George T. Wilson and George Payne, Belmont, Vauxhall, England.

Claim.—"Our improved process of treating them, so as to distil over glycerine with fat acids mixed, but uncombined."

165. For an *Improvement in Welding Iron Plates;* Wm. Bertram, Woolwich, England, Assignor to John W. Cochran, City of New York.; patented in England, December 21, 1854.

Claim.—"Welding the separate faces of such bars or plates together, by pressure or concussion, while at the same time they are subjected to opposite blasts of heat."

166. For an *Improvement in Mowing Machines;* Cornelius Aultman and Lewis Miller, Assignors to Ball, Aultman & Co., Canton, Ohio.

Claim.—"Connecting the cutter bar to the machine, by the double rule joint, or the double jointed coupling piece."

167. For an *Improvement in Compositions for Working Steel;* Horace Vaughn, Providence, Rhode Island.

Claim.—"The dry chloride of sodium and bi-chromate of potash, with or without the prussiate of potash, for hardening and tempering steel."

168. For an *Improvement in Reflecting Quadrants;* Thomas Hedgcock, County of Surrey, England; patented in England, March 31, 1855.

Claim.—"The detector glass, in combination with the index glass and horizon glass, for the purpose of facilitating observations."

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169. For an *Improved Self-setting or Self-raking Saw for Sawing Machinery;* Aza Arnold, Washington, D. C.

Claim.—"The combination of a retreating motion, with the edged reciprocating saw; by which combination, I can give any desired adjustment of cut and feed at pleasure, to enable the saw to cut during its whole descent."

170. For an *Improvement in Printing Instruments for the Blind;* A. Eley Beach, Stratford, Connecticut.

Claim.—"1st, Causing the types to strike at a common centre. 2d, Connecting each of the type keys, or their equivalents, with the escapement, by means of a common connexion."

171. For an *Improvement in Smoothing Irons;* Leander M. Bonyton, Worcester, Mass.

Claim.—"Forming the lower part of the iron with side walls projecting above the upper surface thereof, for the double purpose of securing the upper portion to the lower portion, and directing the draft in heating the upper surface of the said lower portion. I claim only the mode of construction."

172. For an *Improvement in Hemp Breakers;* R. W. Bowen, Marshall, Missouri.

Claim.—"The peculiar construction of the upper and lower blades of the brake, so that they shall approach each other at the same moment, but with different velocities; that is to say, pivoting the lower blades, at or near their front ends, in a firm frame, and connecting their rear ends to the top blades, which are pivoted at a point about two-thirds of their length, in a solid frame, and operated in front."

173. For an *Improvement in Fire Arms;* Fordyce Beals, New Haven, Conn.

Claim.—"The arrangement and combination of parts, using the arm pivot or axis, in connexion with the pawl and hammer, for the purpose of rotating the chambered breech or cylinder—using the arm pivot or axis in its combination and arrangement of parts."

174. For an *Improved Alarm Lock;* Julius Cone, Yellow Springs, Ohio.

Claim.—"Disconnecting the knob-shaft from the latch-bolt; thereby dispensing with a key, key-hole, separate key, bolt, and all devices for operating a key-bolt. Also, placing the alarm spring and scape wheel upon the knob-shaft itself, when combined with the arrangement for connecting said knob-shaft with, and disconnecting it from the alarm,

so that said alarm may not interfere with the ordinary use of the lock, simply for a latch. Also, the disk constructed and operating in connexion with the bolt, alarm, and 'ward spring.' Also, the ward spring. Also, the notch in the knob-shaft, in combination with the slot in the bolt."

175. For an *Improved Mode of Securing Shafts to Axles;* William Cox, Doylestown, Pennsylvania.

Claim.—"The two bars, with the jaws attached to them; the bar being elastic, and having a screw passing through it, on which a nut is fitted—the bars being attached to the axle."

176. For an *Improved Vise;* Horace B. Chaffee, City of New York.

Claim.—"The supplementary jaw, pivoted to the stationary jaw of the vise, and connected with the weighted pawl."

177. For an *Improvement in Lime and Guano Spreaders;* William Croasdale, Hartsville, Pennsylvania.

Claim.—"The combination of the cylinder, composed in part of the movable strips with the rubbers."

178. For an *Improvement in Locomotive Lamps;* Samuel E. and Henry B. Cleveland, Buffalo, New York.

Claim.—"The arrangement and combination of the valve with the plunger and spring, for the purpose of forcing the oil from the can or reservoir, to the burner or wick."

179. For an *Improvement in Rotary Pumps;* Stephen D. Carpenter, Madison, Wis.

Claim.—"The cones, connected by the propellers, in combination with the diaphragm or disk. Also, the semi-spherical shells, in combination with the conducting pipes."

180. For an *Improvement in Reapers;* Owen Dorsey, Triadelphia, Maryland.

Claim.—"Driving the sickle or communicating motion thereto, by means of the crank-pulley, pitman, arms, and shaft, whereby four vibrations of the sickle are obtained at every revolution of the crank-pulley."

181. For an *Improved Water Wheel;* Wilber M. Davis, Carmel, Maine.

Claim.—"The combination of the scroll plate and water pitchers, to secure more beneficially the direct action of the water, in combination with the cone, spreading the bottom of the wheel with a curved float, narrowed at the bottom, and set spirally upon the cone, which, with the scroll plate and pitchers, secure the full direct action and reaction force of the water upon the weeel."

182. For an *Improvement in Shoemakers' Edge Planes;* Isaac A. Dunham, North Bridgewater, Massachusetts.

Claim.—"My improved tool, having part of its moulding edge stationary, and formed with a cutting edge; and the other part of said moulding edge made movable, with respect to the first, and so, that while cutting with the tool, the moulding surface of both parts may rest in contact with the material which is to be cut—my tool enabling me, also, to polish the reduced surface, while a shaving is being removed."

183. For an *Improved Method of Cooling and Drawing Fluids from Casks, &c.;* F. Espenschade, Williamsport, Pennsylvania.

Claim.—"The vessel, provided with an ice chamber, and having a pump connected with it, and the vessel communicating with the barrel by means of the pipe."

184. For an *Improved Method of Felling Trees by Saws;* George C. Ehrsam, City of New York.

Claim.—"The collar or band, with annular rotating rack or rim attached, and the chisel or cutter, fitted within the socket, which is attached to the rack or rim, the chisel or cutter having portions of screw threads on its under side, which fit between a spiral thread on the collar or band."

185. For an *Improved Mode of Detaching Horses from Vehicles;* Francis M. English Hopkinsville, Kentucky.

Claim.—"The combination of pins with the levers."

186. For an *Improvement in Hanging Grindstones;* David Hinman, Berea, Ohio.

Claim.—"Hanging grindstones, having the shaft and flanch with or without a cast in one piece, with the stone firmly secured thereto by the shrinking of the metal."

187. For an *Improvement in Adjustable Cut-offs for Steam Engines;* Henry J. and Thomas Hawkins, Mobile, Alabama.

Claim.—"The adjustable cam and self-inserting toe, which, when combined together on any rock shaft motion for working steam valves, can cut off the steam at any given point, on either motion of the piston, at a moment's notice."

188. For an *Improvement in Seed Planters;* George Hall, Morgantown, Va.

Claim.—"Hanging the cams that operate the seed slides, to the face of the drive wheel, so that they can be swung into or within recesses cut in the face of said wheel, for the purpose of adapting the machine to planting at variable distances apart."

189. For an *Improvement in Plotting Instruments;* Charles R. Iliff, Falmouth, Ky.

Claim.—"The combination of the trammel with the drawing stand, which is provided with the angular and offsett adjustments, whereby an instrument of greatly increased capability is produced."

190. For an *Improved Wrench for Gas Pipe, &c.;* Gustavus A. Jenks, Worcester, Massachusetts.

Claim.—"Arranging the hook or claw and the spring, with respect to the slide and the main bar, and hinging or jointing the claw directly to the slide."

191. For an *Improved Envelope;* Robert T. Knight, Philadelphia, Penna.

Claim.—"The lapping of the ends of the envelope, when they are to be secured by metallic eyelets."

192. For an *Improved Arrangement of Means Attached to Ice Boats;* Daniel Large, Philadelphia, Pennsylvania.

Claim.—"The arranging in the after part of the boat, of the two troughs, for throwing by the power and impulse given by the paddle-wheels, the broken and floating ice upon the fast ice, on each side of the channel, and thereby keeping the water clear for the passage of vessels."

193. For a *Portable Field Fence;* Benjamin F. Lyon, Pleasantville, Penna.

Claim.—"1st, The construction of the mortise in my fence posts. 2d, The construction of my rails, with the shoulders and ends of the dove-tail round; and, also, with the dove-tails made reverse, and on the opposite sides of the rails."

194. For an *Improvement in the Running Gear of Carriages;* Richard Murdoch, Baltimore, Maryland.

Claim.—"The swivel bar and boxes, in combination with the short rails connected with the extremities of the cross bar."

195. For an *Improved Tool for Cutting Metals;* John Mooney, Providence, R. I.

Claim.—"The use of the blade or cutter, of a separate piece of metal inserted in an adjustable clamp."

196. For an *Improved Method of Turning Tapering Forms;* H. E. Salisbury, Platea, Pennsylvania.

Claim.—"The manner for operating the revolving cutters, by means of cam, lever, movable face plate, with radiating arm passing through slots, with slides on revolving face plates, for the purpose of opening and closing the cutters, and holding the timber stationary. Also, the movable centre-piece, operating in combination with the feed motion."

197. For an *Improvement in Running Gear of Vehicles;* Henry Phelps, White Hall, North Carolina.

Claim.—"The combination of the elastic rods, with the rods jointed at *f*."

198. For *Improved Tubular Elastic Valves;* Franklin Peale, Philadelphia, Penna.

Claim.—"The method of adapting flexible valves to flexible tubes, and inserting them therein."

199. For *Self-regulating Wind Wheels;* Francis Peabody, Salem, Mass.

Claim.—"Regulating the velocity of the wind wheel, by means of the secondary blades."

200. For an *Improvement in Hand Seeding Machines;* Silas G. Randall, Rockford, Illinois.

Claim.—"In combination with the reciprocating motion of the seed slide, the locking and unlocking of it, at each planting operation, so that the tongue shall be firmly held against the resistance of the earth in forcing it out, and the sheath therein."

201. For an *Improved Machine for Making Rake Teeth;* Charles R. Soule, Fairfield, Vermont.

Claim.—"The shaft, with loose pulley and projection attached, and used in connexion with the frame and lever, with rod attached, and the lever connected with the arm, having the spring attached, the arm having the lever secured to its end."

202. For an *Improved Pug Mill for Mixing Clay;* Carl T. Schlickeysen, Berlin, Prussia; patented in England, Feb. 24, 1856.

Claim.—"1st, The employment of the clearing knife, in combination with the hopper, the tapering case and beaters. 2d, The rotating bottom, in combination with the beaters."

203. For an *Improvement in Fountain Lamps;* Nicolaus Linden, Jersey City, N. J.

Claim.—"Constructing the reservoir of two cylinders,—one placed within the other, the inner cylinder being provided with a valve, attached to springs; said valve being opened at the proper points, by the projections on the inner side of the cylinder."

204. For an *Improvement in Washing Machines;* V. R. Stewart, Weedsport, N. Y.

Claim.—"The combination of the corrugated or fluted cylinder, and reciprocating board."

205. For a *Tidal Alarm Buoy;* John Taggart, Roxbury, Mass.

Claim.—"The combination and arrangement of the air tank, the stream or current wheel, the bell and mechanism for causing said bell to be sounded during the rotary movements of the wheel, produced by the action of a current in the water. Also, arranging or combining with the stream wheel, the bell, the striking apparatus and air tank, the enlosing or guard frame, and the pendulum or weighted lever applied thereto, the same operating together."

206. For an *Improvement in Safety Hatches for Warehouses;* Wm. H. Thompson and Eustis P. Morgan, Biddeford, Maine.

Claim.—"An elevator, having arms or guides attached to the traveling car or platform, either above or below it, together with the sliding or hinged movable doors, which remain closed when the elevator is not in use, and are opened by the action of the car, or suitable attachments to the same, as it passes upwards or downwards through the several stories of the building."

207. For an *Improvement in Fire Arms;* James Warner, Springfield, Mass.

Claim.—"1st, The combination of the recoil and adjusting pin, with the revolving breech placed in the shield plate, in such position, that the point shall be in line with the barrel. 2d, Forming cavities in the battery plate, in such position, and of such form as to receive and hold the ball or balls, in case of the accidental discharge of any of the chambers not in adjustment with the barrel."

208. For an *Improved Dividing Shoe for Mowing Machines;* Walter A. Wood, Hoosick Falls, New York.

Claim.—"The particular form and construction of a dividing shoe for mowing machines, by means of which, the grass on either side of it is divided and bent over, without breaking or crushing, so that the sickle will reach it all, and thus prevent combing or ridging."

209. For an *Improvement in Harvesters;* Cyril B. Wagner, Philadelphia, Pennsylvania.

Claim.—"In combination with the main supporting and driving-wheel, and the main frame and its supporting wheel, the tongue frame, so united, that the motion of one shall not injuriously affect the action of others."

210. For an *Improved Cutting Apparatus for Harvesters;* Cyril B. Wagner, Philadelphia, Pennsylvania.

Claim.—"Forming the finger or guard, having said depression, with an additional depression, and so uniting the sickle and sickle bar thereto, as to facilitate and render easy the cutting."

211. For an *Improvement in Safety Cans for Burning Fluids;* Seth E. Winslow, Philadelphia, Pennsylvania.

Claim.—"The conical form of the wire cloth strainer, with a small aperture at its apex or side, which may be adapted to the lower part of the lamp tops, and to cans."

212. For an *Improvement in Operating Cut-off Valves for Steam Engines;* Wm. Wright, Hartford, Connecticut.

Claim.—"So combining the lifting toe with the lift rod, by means of a supplemental toe or slide bolt, that the arc or curve described by the vibration of the lifting toe, shall effect a lateral movement of the bolt, thereby tripping the valve."

213. For an *Improvement in Cut-off Valve-checks for Steam Engines;* Wm. Wright, Hartford, Connecticut.

Claim.—"The arrangement for retarding the descent of the valve, namely, the combination of the bell crank with the valve on the one part, and the dash-pot, or equivalent resisting apparatus, on the other; so coupled and operating, that the arm of the crank to which the valve is attached, shall be approaching its greatest throw, thereby checking the rate of descent of the valve, by a force compounded of the diminished speed and diminished pressure."

214. For an *Improvement in Spring Bottom Bedsteads;* Alvah Foot, North Blandford, Assignor to self and Ira Russell, Dedham, and A. B. R. Sprague and Henry Phelps, Worcester, Massachusetts.

Claim.—"Combining with the bedstead and its system of bands and springs, the extension devices or bars, and screws, whereby advantages are obtained."

215. For an *Improvement in Grain Drills;* Abraham Fravel, Assignor to self and Thos. D. Lemon, La Porte, Indiana.

Claim.—"The combination of tooth, cutter, and lever, with shoe, guard, and tumbler."

216. For an *Improved Method of Operating Steam Valves of Steam Pumps;* Remy Henry, Melrose, N. Y., Assignor to James Smith, City of New York.

Claim.—"1st, Giving motion to the steam valve of a steam pump, by the alternate action of the steam and pump pistons. 2d, The combination of the sleeve, the lever, the fork, and the spring, to communicate the requisite movement to the steam valve."

217. For *Shields to Protect Breastpins;* John H. Phillips, Assignor to Leigh R. Holmead, Washington, D. C.

Claim.—"The employment of a shield or plate, with one or more lips or lugs."

218. For an *Improved Farm Gate;* George Taylor, Richmond, Assignor to Harrison Ogborn and George W. Stigleman, Wayne County, Indiana.

Claim.—"The combination of a gate with the angular lever in such a manner, and so related to each other, that the gate shall stand upon a level, both when open or closed. And, further, the combination of the cam with the lever, or its equivalent, for the purpose of vibrating the levers,—thereby opening and closing the gate."

219. For an *Improvement in Looms;* Lucius J. Knowles, Warren, Massachusetts.

Claim.—"The application of the spring to the jack, the vibrator, the toothed cylinder, under their arrangement, in order to enable the cylinders not only to effect the movements of the vibrator by the aid of its spring, but to be continuously rotated or maintained in constant and not intermittent rotary motion. Also, combining the double shuttle or drop box, with one of the levers or jacks, by means, viz: the rod, the elevator, the friction roller, and slide bar; and so that such drop box may be operated by the toothed cylinder of the harness levers or jack."

Additional Improvements.

1. For an *Improvement in Breech Loading Fire Arms;* Abner N. Newton, Richmond, Indiana; patented June 27, 1854; additional dated June 17th, 1856.

Claim.—"1st, A swivel jointed cylindrical breech pin, the rear portion of which is armed with lugs, and studs, and an inclined plane. 2d, The locking of the cylindrical breech pin, rotating on slightly inclined planes, said planes formed within the barrel on opposite sides, and at the rear of the mortise. 3d, The peculiar combination and

arrangement of the four parts or pieces of an ordinary gun lock, to wit: the hammer, main-spring, tumbler, and feather spring; making one plain simple piece. 4th, I claim the slotted thumb lever, in combination with the studs, whereby the swiveled breech is caused to rotate from left to right, and from right to left, in locking and unlocking said breech, and whereby the breech is also moved back and forth."

RE-ISSUES FOR JUNE, 1856.

1. For an *Improvement in Self-Sealing Preserve Cans;* Robert Arthur, Philadelphia, Penna.; patented Jan. 2d, 1855; re-issued June 10th, 1856.

Claim.—"The employment of elastic packing, arranged in, and retained by, a groove of an acute form, or whose sides are in close proximity."

2. For a *Machine for Cutting the Threads of Wood Screws;* Cullen Whipple, Assignor to self, and the New England Screw Co., Providence, Rhode Island; patented August 18th, 1842; re-issued March 5th, 1850; re-re-issue June 13th, 1856.

Claim.—"1st, In combination with the shaft or mandrel which gives the rotary motion to the screw blank, the employment of the rotating wedge-formed cam, or the equivalent thereof, for determining the pitch of the thread, and for permitting the return motion to repeat the operation. 2d, Causing the chaser or cutter at each successive cut, to approach nearer to the axis of the screw blank, by means of a revolving conical cam, which at each successive operation acts by a greater radius. 3d, Governing the motions of the chaser or cutter, to make the core or body of the screw of a conical or tapered form along the whole or any part of its length, by combining therewith a cam of gradually enlarged diameter, the form of such cam depending on the form intended to be given to the core or body of the screw. 4th, Combining the cam which determines the form of the core or body of the screw, (to make it tapering or conical in whole or in part.) with the chaser or cutter by means of a rock-shaft and adjusting lever, the said adjusting lever being interposed between one of the arms of the rock-shaft and the face of the cam, so that by the use of a set-screw, or other analogous device, the cutter or chaser may be readily set. 5th, Shifting the cam which determines each successive cut of the chaser or cutter, by combining therewith, a ratchet movement operating by an eccentric or cam, the wheel of the ratchet being provided with pins which operate a lever connected with the cam to shift. 6th, Disconnecting the shaft or mandrel from the driving power at the end of each complete operation of the machine, by combining the clutch, or the equivalent thereof, with the ratchet, by means of an index wheel or perforated rim, which at the required periods liberates or acts upon the connexions of the clutch, to disengage it. 7th, Making the chaser or cutter, for chasing or cutting the threads of wood-screws by machinery, with a groove of the form of the thread in its cutting face, and in the direction of its length, whereby the said chaser can be sharpened by simply grinding off at the end, and without changing the form of the groove, and whereby, also, the said chaser cuts on both sides of the thread, and finally on the edge thereof. 8th, The combination of the screw driver, for holding and rotating the screw blank, with the tubular rest open at the side to support the shank of the blank while being threaded."

3. For an *Improvement in Bellows for Musical Instruments;* Jeremiah Carhart, City of New York; patented December 28th, 1846; re-issued June 24th, 1856.

Claim.—"The combination of the reeds with an exhaust chamber of variable capacity, and an air pump whose action exhausts and rarifies the air therein, the exhaust chamber tending to expand with a force that will balance the rarification to be preserved in the chamber."

4. For an *Improvement in Annealing Furnace;* J. Joseph Eagleton, City of New York; patented May 20th, 1856; re-issued June 24th, 1856.

Claim.—"Charging and discharging an annealing furnace in bulk. Also, opening the bottom of the annealer for the purpose of discharging its contents, and re-charging it. Also, the employment of a continuous heat, with an air-tight annealer, by which iron wire can be annealed with the same facility as brass and copper, where the air is not required to be exhausted."

DESIGNS FOR JUNE, 1856.

1. For *Cooking Stoves;* William Resor, Cincinnati, Ohio; June 3d, 1856.

Claim.—"The design for the 'Lotus' cooking stove."

2. For *Cooking Stoves;* William Resor, Cincinnati, Ohio; June 3d, 1856.
Claim.—"The design for the 'Kentucky' cooking stove."

3. For *Stoves;* Isaac Diller, Lancaster, Penna.; June 17, 1856.
Claim.—"The arrangement, &c., of ornaments for a parlor oven stove."

4. For *Cooking Stoves;*
5. For *Air-tight Stoves;*
6. For *Nine-Plate Stoves;*
7. For *Stoves;*

G. Smith, H. Brown and J. A. Reed, Assignors to Abbott & Lawrence, Philadelphia, Pennsylvania.

Claims.—"To the design, &c., of the ornaments and mouldings in bas-relief, &c."

8. For *Stoves;* Samuel W. Gibbs, Assignor to Treadwell, Perry & Norton, Albany, New York: June 17, 1856.
Claim.—"The combination, &c., of the ornamental figures and forms."

9. For *Cooking Stoves;* Stratton & Massey, Assignees of John F. Allen, Philadelphia, Pennsylvania; June 17, 1856.
Claim.—"The general form and proportions, combined with the mouldings, figures, and ornaments."

10. For *Stoves;* Samuel W. Gibbs, Albany, New York, Assignor to North, Chase & North, Philadelphia, Penna.; June 24th, 1856.
Claim.—"The design, &c., of the mouldings and ornaments."

11. For *Stoves;* Samuel F. Pratt, Boston, Mass., Assignor to Treadwell, Perry & Norton, Albany, New York; June 24th, 1856.
Claim.—"The combination, &c., of the ornamental forms and figures."

12. For *Stoves;* N. S. Vedder and Wm. L. Sanderson, Troy, New York, Assignors to North, Chase & North, Philadelphia, Penna.; June 24th, 1856.
Claim.—"The design, &c., of the ornaments and mouldings."

13. For *Cooking Stoves;* G. Smith, H. Brown and J. A. Read, Assignors to Leibrandt, McDowell & Co., Philadelphia, Pennsylvania; June 24th, 1856.
Claim.—"The combination of the various ornaments and mouldings on the several plates and doors."

MECHANICS, PHYSICS, AND CHEMISTRY.

*On the Commercial Economy of Working Steam Expansively in Marine Engines.** By Mr. Edward E. Allen, of London.

(Continued from page 57.)

Referring now to Section D, Table XXIII, it appears that by using steam of 80 lbs. pressure instead of 35 lbs., the annual saving in coal will amount to 14¼ per cent. of the original capital; and that the same quantity of coals will last ninety-three days instead of forty. Also, if the pressure be increased to 120 lbs., the annual saving in coal will amount to 16¼ per cent. on the original capital; and the same quantity of coals will last 114 days instead of 40.

Again, if instead of carrying coals for an additional number of days, the space they would occupy, be appropriated to cargo, then, by the central columns, on the supposition that the total machinery and coal-space, is equal to ⅔ds of the total cargo-space, the latter will be increased 12 and 18 per cent. when the size of the engines is increased to two and three times respectively, and 24 and 27⅓ per cent. when the pressure is

* From the London Artizan, April, 1856.

increased to 80 and 120 lbs. respectively. By the last columns of Section D., it will be seen, that, on the same supposition, and supposing the net profits for two years, to be equal to the cost of vessel, that is, the receipts on the cargo-space to be 50 per cent. of the original capital, then the total annual gain, from saving in coals and increase of cargo-space, will be 13¼ and 19¾ per cent. of the original capital, when the size of the engines is increased to two and three times respectively, and 26¼ and nearly 30 per cent. when the pressure is increased to 80 and 120 lbs. respectively.

These results are of the highest importance, and well deserve the consideration of those embarking capital in undertakings of this nature.

In concluding this examination of the beneficial effects of expansion, the author may remark, that there are various aspects and suppositions under which they might be demonstrated, and few can be more fully aware than himself of the imperfection which might be found in these contributions to the subject. It is difficult to present a comprehensive view of the subject in an abstract form; but perhaps enough has been done to serve as a ground-work upon which calculations suited to specific cases can be based; this may be done by substituting the correct quantities in any particular case, for those given in the Tables.

TABLE XXIII.—SECTION D. GENERAL SUMMARY.

Table compiled from the three foregoing Tables; the cost, weight, and space of engines, boilers, and passages, and water, being constant; the pressure increasing from 35 *to* 80, *and* 120 *lbs.* (*the intermediate pressures being omitted*), *the size of nominal* H. P. *of the engines, and the indicated* H. P. *remaining the same.*

Class.	Service.	Total pressure of steam in lbs. per square inch.	Annual saving of coal in per centage of capital (Table XVIII.).	Increase of capital per cent.	Total weight of coal and machinery: decrease per cent. (deduced from column 6, section A).	Total space occupied by coal and machinery; decrease per cent. (deduced from column 6, section B).	Cargo space: increase per cent. When total machinery and coal space is *equal* to total cargo-space.	Cargo space: increase per cent. When total machinery and coal space is 2-3rds of total cargo-space.	Cargo space: increase per cent. When total machinery and coal space is *half* of total cargo-space.	Per centage of increase of time the coals would last, if total weights be kept the same.	Number of days the coals would last, if total weights be kept the same.	Annual per centage gain of capital from saving of coal and increase of cargo-space. If the net profits cover cost of vessel in one year.	Annual per centage gain of capital from saving of coal and increase of cargo-space. If the net profits cover cost of vessel in two years.
					Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.		Per Cent.	Per Cent.
1	River.	35	...	Capital constant; the same engines and boilers, &c., being used in all cases	...	...	...	...	...	...	2½	...	...
		80	8·55		11·00	14	14	9⅓	7	132	5¾	17·88	13·21
		120	9·75		13·00	17	17	11⅓	8½	185	7	21·08	15·41
2	Coasting and Continental.	35	...		...	...	...	...	...	...	10	...	...
		80	2·85		28·50	29	29	19⅓	14½	132	23	22·18	12·51
		120	3·25		32·50	33	33	22	16½	185	28	25·25	14·25
3	Ocean (short voyages) and Government	35	...		...	...	...	...	...	...	15	...	...
		80	2·85		34·00	29	29	19⅓	14½	132	35	22·18	12·51
		120	3·25		39·00	33	33	22	16½	185	42¾	25·25	14·25
4	Ocean (long voyages) Australian.	35	...		...	...	...	...	...	...	40	.....	.....
		80	14·25		45·60	36	36	24	18	132	93	38·25	26·25
		120	16·25		52·00	41	41	27⅓	20½	185	114	43·58	30·91
5	Ocean (voyage out and home).	35	...		...	...	...	...	...	...	70	.....	.....
		80	2·85		49·87	36	36	24	18	132	162	26·85	14·85
		120	3·25		56·87	41	41	27⅓	20½	185	209	30·58	16·91

In the former paper the author made a deduction from the annual saving in coal, for the interest on the extra capital required for larger engines of the ordinary construction; but no provision was made for the repayment of such extra capital. This might be rendered more simple, by supposing the gain from saving in coals and increased cargo-space, to be set aside until the extra capital was repaid. This would be done in a few years, according to the ratio which the annual profits bore to the capital. After the repayment of the extra capital, the annual gain would be constant, and no reduction would have to be made for interest, the profits resulting from saving of coal and increase in cargo-space.

The author will now refer to the advantages contemplated in the new forms of engines proposed in the former paper, which are as follows:—

1st. That the steam on its entrance to the cylinder, acting on a comparatively small area, would admit of the pressure being considerably increased, without the weight of the engine being increased to anything like the extent, necessary in the case of a common cylinder of large area.

2d. That in order to work expansively, it would not be necessary to increase the length of the cylinder or stroke of the engine, which would be the case with an ordinary engine: the double expansion rendering the length of cylinder virtually double.

3d. That the arrangements proposed possess all the advantages of compactness obtained by the use of a trunk, thus conveniently allowing of a longer connecting rod than would be possible in any other way in the same space.

4th. That upon either of the plans represented in the Drawings, (see *Journ. Frank. Inst.*, vol. xxxi., pp. 336-37-38,) the power of the engines could be almost indefinitely increased, not only by using steam of higher pressure, but also by increasing the *diameter* of the large cylinder; retaining a short stroke for the sake of getting sufficient speed for a screw-engine.

5th. That the floor-space required for the engines, on these plans, would not exceed from $\frac{1}{4}$ to $\frac{1}{3}$ of a sq. ft. per nominal H. P., or about half the space usually occupied by other direct acting engines; the pressure and degree of expansion, being supposed to be in both cases the same.

6th. That the space required for the engines, so as to obtain a greater degree of expansion than usual, (greater capacity of cylinder, under whatever form or arrangement being of course necessary,) would not increase in a higher ratio than that in which the space occupied by the boilers would decrease, less steam being required for the same power; so that the total spaces would remain constant for almost any degree of expansion.

7th. That the steam from its entrance to its exit, would work against a vacuum.

8th. That the difference of pressure at the beginning and end of the stroke would be very considerably less, than in an ordinary engine expanding to the same degree. For example: suppose an ordinary single cylinder, with steam at 45 lbs. expanding nine times, or to 5 lbs.; then, deducting the back pressure, say 3 lbs., we have $45 - 3 = 42$ lbs. at

the beginning, and 5 — 3 = 2 lbs. at the end of the stroke, being in the ratio of 21 to 1. If the expansion take place in two stages, as in the arrangements proposed, then for the first stage, we have 45 — 3 = 42 lbs. at the beginning, and 15 — 3 = 12 lbs. at the end of the stroke, being in the ratio of $3\frac{1}{2}$ to 1 only; and for the second stage, (taking place in the opposite cylinder), we have 15 — 3 = 12 lbs., and 5 — 3 = 2 lbs., being in the ratio of 6 to 1 only. The mean total difference is only $4\frac{3}{4}$ to 1, and this for the same degree of expansion of 9 times.

9th. That the combination of the trunks, not only counteracts the atmospheric pressure on the outer ends of them, which would prevent much expansion, but also save the second connecting rod, and further serves the purpose of guides, and prevents the work of the connecting rod being thrown too severely on the trunk and stuffing box. The combination of the trunks also renders the work done by the out and in strokes (of a horizontal engine), quite equal; the high pressure steam of one cylinder, always acting in conjunction with the low pressure steam of the opposite cylinder. This equality of work in the in and out strokes, cannot well be obtained with a single trunk, except it be carried through the cylinder, as in Messrs. Penn's engine. The only way in which it is ordinarily attempted, is by cutting off the steam later on the trunk side of the piston, by giving the valve less lap on that side. This method of obtaining uniformity is obviously very limited, and not compatable with high degrees of expansion.

10th. That owing to the strength of the various parts of the engine being determined by the pressure of the steam on its first entrance into the cylinder, and this taking place on a comparatively small area, the cost and weight of engines would not increase as on the ordinary construction; and it is presumed that the reduction in the cost of boilers, owing to less steam being required for the same power, would cover an extra cost of engines arising from the greater capacity of cylinder, which is required in order to work more expansively than usual.

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Mr. Allen explained the drawings of his engine, and the mode of its action. He stated that his view had been principally to obtain compactness and sufficient uniformity in the power, combined with a much higher degree of expansion than was at present used in marine engines. There were many practical difficulties in the more extended application of the expansive principle in those engines, on account particularly of the very confined space available for them in the vessels.

The Chairman inquired whether the calculations in the paper had been made only theoretically; he supposed no actual trial of the engine upon the new arrangements proposed had yet taken place.

Mr. Allen explained that the calculations had not been made from actual indicator diagrams, as there had not been an opportunity at present of making a trial of an engine on the proposed plan; but he had made the calculations from carefully constructed diagrams, based on those obtained from the actual working of engines that were so far similar in their action, as to afford safe practical data for the calculations, and full allowance had been made for loss of temperature during expansion of the steam.

The Chairman observed that strong objections were generally enter-

tained by marine engineers to the use of high pressure steam for their engines; greatly on the ground, he believed, of priming, arising probably from the quantity of salt in sea water; but he did not see why these difficulties should not be surmounted.

Mr. Allen stated that in his original paper, which was read at the previous meeting, he had confined his attention to the case of low pressure steam, 35 lbs. total pressure, or 20 lbs. above the atmosphere, as that was the general limit at present in marine engines; but in the present supplementary paper, he had extended the calculations given in the previous one to the case of high pressure steam, in accordance with the desire expressed in the former discussion.

The Chairman inquired what means he proposed for getting over the difficulties which were met with when high pressure steam was used?

Mr. Allen said that the object of his paper was not to investigate any special means of getting over the difficulties accompanying the use of high pressure steam, but merely to show what advantages in point of economy would result, in case some effectual method of overcoming them could be devised.

Mr. Jones observed that facts obtained by actual trial were very essential for confirming theory on such a subject, which was one in which it would be important to have the calculations verified by practical experience; he considered that the calculations in Mr. Allen's paper threw much valuable light on the economy of expansion.

Mr. Hodge thought there would be much liabilty to error in basing calculations on theoretical tables only, not derived from experiments, and in adopting a new design of engine, like that brought forward in connexion with the paper, which had not yet been tried in practice. He disapproved of the short stroke of the engine proposed, since the total effect with the same expansion, that is, cutting off at the same friction of the stroke, was not so good in a short stroke engine as in a long one; but he considered the use of the two cylinders an advantage, on account of the greater uniformity of motion thereby obtained; the latter, however, was not a point of such importance in the propulsion of vessels as in manufactories, since the momentum of the vessel was great, and not easily affected by irregularities in the stroke; but in driving machinery, all variations in the power given out at different portions of the stroke were detrimental. The arrangement of the trunks for shortening up the engine appeared very good, but he thought the cylinders were shorter than was advisable, because less power was obtained out of the steam, by expanding the same volume of steam in a short cylinder than in a long one, as was shown by adding up the ordinates of the expansion curves.

The Chairman inquired whether the form of engines represented was expressly designed for high pressure steam, or whether any other form would be considered preferable in that case.

Mr. Allen replied that the engines were not designed for very high pressure steam, but only for pressures of about 35 to 45 lbs. including the atmosphere; the advantages contemplated in them, were those arising from saving in cost and space occupied, and from allowing the expansion to be carried to a higher degree than usual; large trunks might be objectionable with very high pressure, as the effects of the difference in area

would then be rendered more perceptible. The advantage of a long stroke was admitted, but it appeared to be impracticable to obtain a long stroke in a marine engine, with sufficient velocity of revolution of a screw shaft.

The Chairman inquired what was the velocity of revolution proposed with Mr. Allen's engines.

Mr. Allen contemplated working them up to 80 or even 100 revolutions per minute, which was about the speed required for screw shafts; this would give a speed of piston of about 300 ft. or 400 ft. per minute.

Mr. Hodge thought an engine might be driven at a considerably greater speed without difficulty; he had known 600 or 700 ft. per minute attained without difficulty in a long stroke engine, and a good indicator diagram obtained at that speed.

The Chairman remarked that, independently of the difficulty of obtaining a long stroke with a great velocity of the shaft, the section of the vessel would not generally allow of a long stroke sufficiently low down for direct acting horizontal cylinders.

Mr. Hodge said that the balancing of the cylinders by connecting the opposite trunks, appeared to him to be a new and good arrangement; he had not seen it before, and it certainly made the engine very compact; but he did not see that it was accompanied by sufficient advantages to warrant complicating the engine so much as was done by the proposed arrangement.

Mr. Allen explained that it was not necessary to use four cylinders in order that the atmospheric pressure upon the open trunks might be balanced, as this could be done by working the opposite trunk in a condenser; by connecting the opposite trunks, the effects of the variation of the pressure during expansion were diminished, and the atmospheric pressure was entirely neutralized; the four cylinders were, however, desirable where the expansion was carried down to the extent contemplated in the paper—namely, 5 lbs. above a vacuum, as the total power exerted in both directions was thus rendered quite equal. Without the trunk the same amount of expansion could not be obtained without having engines with a long stroke.

Mr. Hodge presumed the extent of expansion was limited only by the power required to overcome the friction of the engine.

Mr. Allen pointed out that the steam might be expanded with advantage to this limit in the engines he had proposed, as when the most expanded steam was acting on the large area piston, there was, in addition to this, when the trunks were coupled, the steam at its highest pressure acting on the small area in the same direction.

Mr. Hodge thought that in horizontal direct acting engines, there was often a great error in not having sufficient length of bearing in the stuffing-boxes, and also in the pistons; it was proved in practice that there was no disadvantage in a long bearing piston if well made. He considered that long-stroke single-cylinder engines were the most economical, and were preferable wherever that form was admissible.

The Chairman remarked that considerable economy was obtainable by a greater degree of expansion, even with the present pressure; but for carrying out the principle thoroughly, it was essential to obtain a

considerable increase of pressure, and he thought it was very important for an advance to be made in that direction.

Mr. Allen observed that doubling the size of the cylinders, gave an economy of 29 per cent., with the same pressure as that generally used, 35 to 40 lbs. per inch, which would be a very important improvement on the present working. There were several practical objections to the use of higher pressures of steam, and he was not prepared to recommend much increase at present.

Mr. Hodge inquired what objections were generally advanced to the use of higher pressures; he did not know of any really serious objection, and thought the pressure might be much increased beyond the present average, with important advantage in economy of power.

Mr. Allen said the objections were mainly those arising from minor points of detail, such as priming and leakage of stuffing boxes and boiler joints; these were practical difficulties which might very possibly be got over with further experience.

The Chairman suggested that the general objection to high pressure steam in marine engines was to be attributed to the circumstance of those connected with them not being so much accustomed to high pressure steam; there did not appear to be any sufficient reason why it should not be used as much in marine as in land engines, and particularly in locomotives. He thought the difficulties met with in connexion with the boiler were such as ought to be got over, and would be set aside by engineers accustomed to construct high pressure steam.

Mr. Hodge remarked that marine engineers in this country had mainly confined their attention at present to the low pressure steam; but in the large American steamers on the Hudson, condensing engines were worked with 70 lbs. steam, and a good vacuum of 28 in. was maintained without difficulty with that pressure. Of the difficulties which were urged, priming, he believed, often arose from the steam pipe from the boiler being too small in diameter; he had known cases where this had been the cause. The stuffing boxes ought to give no trouble; they were always made steam tight with high pressure steam, by the Cornish engineers, and in locomotive shops, and if not steam tight in marine engines the workmanship must be defective; he thought the difficulties that had been referred to, were such as might be easily got over.

Mr. Allen observed that some difficulties might be treated as trivial in land engines, which became serious matters in the case of marine engines, from the difference in the circumstances; and in considering the extension of expansion in the latter class of engines, it was necessary to take account even of objections arising merely from minor points of detail. He anticipated that the first step towards improvement in marine engines, would consist in using a higher degree of expansion, with the present pressure of steam, and afterwards making trial of greater pressures. High pressure steam had been very little tried yet in marine engines, and had always been found troublesome; he believed that some engines which had been originally constructed with high pressure steam had been afterwards altered to low pressure.

The Chairman observed that the gun-boats lately made for the Baltic fleet, had steam of from 50 lbs. to 60 lbs. pressure, working without

condensing, and he understood they answered very well, and a still higher pressure would probably be tried.

Mr. Shipton suggested that there might be some difficulty with the air-pumps shown in Mr. Allen's engine, from the speed and the position in which they were placed.

Mr Allen remarked that such a difficulty would not affect the principle contained in his paper; any other form of air-pump might be adopted, if desired; but he did not think any difficulty was to be anticipated in working the air-pumps even at a higher speed than he had contemplated.

The Chairman said he had recently seen engines that had worked at 130 revolutions per minute, in a vessel that had been out to Africa; the air-pumps had common leather butterfly valves, very well made, and no difficulty had been experienced from the high speed. He remarked that the great requisite for long voyages, was sufficient surface in the working bearings, to prevent any tendency to heating, in order to allow the vessel to continue running several days without stopping.

Mr. Shipton observed that the trunks shown in Mr. Allen's engine would increase the friction considerably; he inquired whether any account had been taken of the increased friction in the calculations of the paper.

Mr. Allen replied that the friction was not included in the calculations, in order that they might be as general as possible, instead of being limited to a particular form of engine; but he did not think that it would materially interfere with the advantages of his proposed engine.

Mr. Shipton observed, that with the present construction of marine engines, the expansion being performed in a single cylinder, must undoubtedly be more limited than in a compound cylinder, such as had been proposed; otherwise a shock would be caused to the wheels or screw at each stroke by the great inequalities in the driving power; and consequently, with a single stroke cylinder, it was not advisable to cut-off at a very early point in the stroke.

Mr. Allen said that no great degree of expansion could be obtained in marine engines, except by dividing the process into two steps, as in his proposed engine, by the use of double cylinders: it would be seen, by referring to the tables, that with 120 lbs. of steam, in order to expand down to the lowest useful pressure, in the present engines, it would be necessary to cut off at $\frac{1}{18}$th of the stroke, which was quite impracticable in a single cylinder, on account of the variation in pressure being much too great to be admissible in marine engines; it was only possible in such a case as the Cornish pumping engines, where great variation in power and velocity of piston was immaterial. But in his proposed engine this high degree of expansion could be obtained practically, by cutting off at $\frac{1}{9}$th in the first cylinder, and doubling the expansion in the second, or at $\frac{1}{6}$th in the first cylinder, and expanding three times in the second.

The Chairman inquired what degree of expansion was adopted in the large engines, making at Soho for the great vessel of the Eastern Steam Navigation Company.

Mr. Garland said he believed it was not intended to work them very expansively, probably cutting off at about $\frac{1}{3}$d of the stroke; there were

four cylinders, 84 in. diameter, with a 4 ft. stroke, and intended to work with about 25 lbs. steam above the atmosphere.

The Chairman suggested that in many cases, the use of 100 lbs. steam without a condenser, might be practically as economical as 50 lbs. steam with a condenser, and would have the advantage in simplicity and compactness.

Mr. Allen thought that condensing was preferable in all cases, and recommended the use of 40 lbs. to 50 lbs., or 60 lbs. steam rather than a higher pressure; the steam to be expanded down to 5 lbs. He showed by a table that when the expansion was carried down to 5 lbs. above a vacuum, there was practically very little margin left for further economy, and the moving power was then very nearly counterbalanced by the friction and the back pressure of the condenser.

The Chairman remarked that their member, Mr. W. Smith, of Dudley, had given a valuable contribution of actual results, of the working of engines in the mining districts, and he hoped some members would take up with the subject in its different branches, to carry out the inquiry that had been so well commenced. The working results of the Cornish engines had been carefully attended to, and constant returns and comparative statements were prepared, with remarkable advantage to the owners, in the practical economy resulting from the plan; and there would doubtless be found greater advantage also in the extension of the plan to other classes of engines. His own conviction was that it would be necessary in many cases of marine engines, particularly in screw-steamers, to use a much higher pressure than was at present employed; the objections of engine makers to attempting the use of high pressure steam, arose from the several practical difficulties that had then to be encountered; but he did not see any reason to doubt that these might be satisfactorily surmounted by further endeavors and improvements in construction or arrangement. The great importance to the employers of steam power of an extension of the expansive principle, in point of economy of power and increase in the cargo-space available in the vessel, had been strikingly shown in the able paper that had been read to the meeting. He expressed a hope that the views advanced in the paper might be carried out practically, and proposed a vote of thanks to Mr. Allen for his paper and tables, which was passed.

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*D. J. Hoare's Improvements in Screw Propellers.**

Sir,—Having been requested by D. J. Hoare, Esq., to forward you a statement of the results I have obtained in investigating his plan of angular propulsion for screw propellers, I have the pleasure of laying before you the following remarks and experiments:—

Mr. Hoare proposes, by arranging the propeller-shaft at an angle of about 30° with the horizon, to obtain an increase of speed—without an increase of power—over that resulting from the horizontal plan, now adopted.

* From the Lond. Artizan, March, 1856.

By analogy, we may infer that some such result would accrue, as a similar principle is involved in towing on canals, in trimming the sails of vessels, in the construction of wind-mills, in the fins and tail of a fish, &c.; but the chief cause of the advantage obtained in the case of the screw by this arrangement, is, that *both blades* would be immersed, and worked against a more dense body of water than could be obtained by the horizontal plan, at present used, as in that arrangement the upper blade works close to the surface of the water, having little or no fulcrum, and leaves the lower one nearly all the work to do. Mr. Hoare, by his angular plan, obviates this difficulty, as my experiments seem to demonstrate.

On thinking over this fact, I am inclined to believe, that, were it mechanically possible, the horizontal screw and driving-shaft would, by virtue of these inequalities of action, have a tendency to assume an angle with the horizon or direction of the vessel, which would be a general resultant of all the operating forces; and that this angle would be one from which the most beneficial results would be obtained in the application of the propelling force.

To test these suggestions, a boat was fitted with clock-work and a propeller, and every care was taken to ensure uniform and reliable result.

On driving this by the horizontal plan, I obtained, as a mean of many trials:—

Distance run.	Time.
40 ft.	20½ seconds.

Power of clock expended.

I took this as a standard of the horizontal plan.

The machinery was then elevated so as to take together, with the driving shaft and axis of the screw, an angle of 30° with the horizon, the bows, midships, and stem, having the same immersion as in the former experiments. The results obtained were, as a mean:—

Distance run.	Time.
40 ft.	17½ seconds.

Power of clock-work not quite expended.

Now, these results are a proof of the soundness of the principle; but, in these experiments, no just increase of resistance was obtained which would bear a proper ratio to the comparative submersion of the propeller of the model and that of a large vessel. In the experiments this did not exceed an inch, whilst, in practical application, the increased submersion would be some feet, tending, of course, in the latter case, to afford a fuller and more decided result of the conditions of the proposed improvement; in fact, on applying this principle on the large scale, BOTH blades would, at the angle proposed, work against a solid body of water (if we may use the expression), and the resistance to each blade being thus equalized, we should obtain an increase of speed with the exertion of the same power over that from the horizontal plan, just in proportion as this equalization of the action of the blades is carried out. It would also follow that the vibration of the vessel would be lessened, and the situation of the screw would leave the rudder in such a position as to be beyond any influence of the back water.

I am, of course, unprepared to offer any remarks as to the mechanical obstacles which exist in the application of this plan; these, of course, are subjects for the shipbuilder's consideration; but it certainly seems that, by a judicious application of this new plan, combined with recent improvements in the construction of vessels, a great advantage in speed may be obtained, and an economy of working expenses effected.

JAMES WYLDE, Jr.

Royal Polytechnic Institution, February 14, 1856.

For the Journal of the Franklin Institute.

Particulars of the Steamer Guatemala.

Hull built by Wm. H. Webb. Machinery by Fulton Iron Works, New York. Intended service, South American Coast.

HULL.—

Length on deck from fore part of stem to the after part of stern post above the spar deck,	120 feet.	
Breadth of beam amidships,	22 "	
Frames, distance apart *at centres*,		30 inches.
Floor timbers at throats, *molded*, 10 ins., *sided*, 8 to 14 ins.		
Depth of hold,	8 "	
Length of engine and boiler space, including coal bunkers,	44 "	
Draft of water at load line,	5 "	3 "
" " below pressure and revolutions,	5 "	
Area of immersed section at this draft, 90 sq. ft.		
Tonnage, 210.		
Masts and rig—Foretopsail schooner.		

ENGINE.—Vertical beam.

Diameter of cylinder,		30 inches.
Length of stroke,	6 feet.	
Maximum pressure of steam in pounds, 25.		
" revolutions per minute, 22.		

BOILER.—One—Return flued.

Length of boiler,	19 feet.	
Breadth "	7 "	6 inches.
Height " exclusive of steam chimney,	8 "	
Number of furnaces, 2.		
Length of grate bars,	5 "	
Number of flues, 4 above—6 below.		
Internal diameter of upper flues,		16 "
" " lower "	10, 16, and 18½ "	
Length of upper flues,	13 feet.	6 "
Heating surface, 607 sq. ft.		
Diameter of smoke pipe,	2 "	8 "
Height " " above grate,	40 "	
Description of coal, Bituminous.		
Draft, Natural.		

PADDLE WHEELS.—

Diameter,	18 feet	6 inches
Length of blades,	5 "	
Depth "		15 "
Number " 16.		

Remarks.—Cabin on quarter deck. C. H. H.

For the Journal of the Franklin Institute.

Particulars of two Iron Screw Propellers, Leopold, and Duc du Brabant, lately built in Antwerp for the Belgian Transatlantic Steamship Line.

Hull built by John Cockerill. Machinery by Cockerill & Co., Antwerp. Intended service, New York to Antwerp.

HULL.—

Length on deck, from fore part of stem to after part of stern post above the spar deck,	286 feet.	
" at load line,	263 "	
Breadth of beam,	38 "	
Depth of hold,	27 "	8 inches.

Frames—shape and dimensions, ⌐L—6 × 3½ × ⅜—5½ × 3½ × ⅜ —and 5½ × 3½ × 9-16—doubling, or edge-frame—4 × 3 × 7-16—14.
Keel—dimensions, 11 by 2½ ins. Stern-post, 11 × 6.
Plates, thickness—27-32 to 15-32.
Keelsons—two, 24 ins. high, ⅜ths thick, with angle iron at edges.
Floors—24 inches high.

Draft of water at load line,	20 feet.	
Area of immersed section at this draft,	705 sq. ft.	
Tonnage,	Belgian, 1963.	
	English, 1843.	

Masts and rig—barque.

ENGINES—Direct-acting.

Diameter of cylinders,		60 inches.
Length of stroke,	4 feet.	

BOILERS.—Four—Tubular.

Description of coal,	Anthracite or Bituminous.

PROPELLERS—

Diameter of screw,	18 feet.	

Remarks.—Have five water-tight bulkheads. Have plate stringers upon each deck, 32 inches wide, and ½ an inch thick. Hull, clincher built, rivets, ¾ and 1 inch in diameter, and 3 and 2½ inches apart: double laid. C. H. H.

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*The Gums and Resins of Commerce.** By P. L. SIMMONDS.

The subject which I have undertaken to open up for discussion this evening, is one embracing so many important articles of commerce, and extending over so wide a field of research, that I can scarcely hope to do common justice to any even of the great classes into which it naturally divides itself—much less to enumerate or particularize one-half of the various new gums and resins which I should desire to bring more prominently into notice. Any one of these gums or resins would have formed ample field for investigation and inquiry of itself, taking it in its several relations of origin, sources of supply, mode of procuring, quantity obtainable, price, chemical composition, and probable utility, as compared with other similar exudations and their commercial uses.

But in taking a rapid survey of the whole group of gummy and resinous exudations, any such close and full description would be utterly im-

*From the Lond. Journal of the Society of Arts, November, 1855.

possible—and as it is, I shall have to pass over much of the information I have arranged, leaving it for the quiet perusal and future consideration of those who feel greater interest, in its more extended form in the columns of the Society's *Journal*.

In the mode of treating my subject I hesitated at first as to whether it might not be useful to go over each quarter of the globe separately, giving distinct accounts of the gummiferous plants and products of Europe, Africa, Asia, Australia, and America. But on reflection I found that this would entail much repetition, and I am, therefore, necessitated to fall back on the conventional classification usually adopted of true gums, resins, gum resins, oleo resins, and elastic gums, and I hope to be able to furnish something new to our current stock of information under each of these heads.

The importance of this class of commercial products will be better estimated by the statistics I shall be able to furnish of the trade, brought down to within the last year or two.

That there has long been a want of some more detailed information on the gums and resins of commerce will not be denied, for, although much has of late years been done by the several local and metropolitan exhibitions to collect and diffuse correct information, we are still lamentably deficient in details as to the plants that produce very many; and the learned Professor who presides on this occasion, knowing himself how difficult it is to identify plants without the presence of the leaves, barks, and necessary adjuncts, will readily be able to excuse any accidental errors I have fallen into, which his more experienced judgment may be able to correct. Much information respecting the gum-bearing trees of commerce and their products is doubtless to be found scattered through many home and foreign scientific periodicals, but this bears rather on their medicinal value than on their commercial properties and uses in the arts and manufactures, and grave errors continue to be propagated in standard works from day to day; even in a publication of weight and influence like the "*Encyclopædia Britannica*," most of the details in the articles as given in the new edition (as far as it has proceeded,) are nearly reprinted verbatim as issued in its pages some thirty or forty years ago.

There is another work of assumed authority, where one would naturally look for some recent information as to the progress of discovery in new gums and their applications, viz., *Dr. Ure's Dictionary of Arts and Manufactures*, but in the last edition of 1853, the article "Gums" stands verbatim as it did in the edition fifteen years previous, brief and meagre in its character, while that on Resins has merely an addenda of a page to the previous stereotyped matter.

Every one who brings the result of his researches and investigations to bear into the common stock, if he has been diligent and treated the subject fully and fairly, must contribute some few hints that may prove useful, and if I but succeed in doing this, I shall be satisfied.

I must premise that in order to assimilate my information to the erroneous nomenclature of city circles, and commercial lists, I am obliged to depart to some extent from the true scientific definition, and shall speak frequently of many substances as "gums," which are properly gum resins,

or pure resins. Were I not to do this, I should confuse many of those whom I see around me, and who have had to buy and sell by names which were erroneously given years ago, before chemical analysis had determined the true composition of many.

It has been well observed by Professor Solly (*Jury Reports*, p. 71), that "a great deal of practical inconvenience and confusion is caused by the indiscriminate manner in which the term *gum* is used in commerce and the arts. It would certainly be an advantage if the distinctions employed in scientific books, were to be generally adopted by merchants and drug-brokers, the term gum being solely applied to those natural vegetable exudations which soften or dissolve in water, and yield a more or less perfect mucilage, but which are wholly insoluble in spirit; the term *resin* being applied to those fusible and combustible vegetable substances which are quite insoluble in water, but which soften and dissolve in ether, the "essential oils," and "spirits of wine," and the term *gum resin* being used to designate those mixtures of gum and resin which are intermediate in properties, and partake of the nature of each, being partially and imperfectly soluble both in water and in alcohol."

Gum, properly so called, is used in large quantities for a number of purposes in the arts. It is generally distinguished into soluble gum, or gum arabic, which readily and perfectly dissolves in water, forming a clear mucilage, and cherry-tree gum, or gum tragacanth, and those difficultly-soluble kinds of gum, which, though they soften easily, do not readily form mucilage. Gum is extensively used in finishing and giving lustre to crapes, silk goods, &c., by calico printers, shoemakers, and in other trades.

As instances of the immense traffic carried on in gums, I may state that one Liverpool firm imported in three years Gum Senegal to the value of £100,000. Gums to the value of 3¼ millions of francs have been shipped annually from Alexandria. The exports from Morocco reach to 250 or 300 tons, and India exports 1500 or 1600 tons.

The Gum Arabic of commerce is the produce of various species of acacia, which yield this substance in considerable quantities, particularly *A. vera*, a native of Arabia, and of Africa, from Senegal to Egypt, which supplies the finest qualities; *A. Arabica*, a smaller tree, common in India and Africa, which yields part of the Turkey and East India gum; the red pieces constituting the gum gedda and gum babool of commerce.

A. gummifera, a high, thorny tree, found near Mogador, the coast of Guinea, and in Arabia, furnishes what is known as Barbary gum, a darker variety.

A. Senegal yields part of the Senegal gum, the tears of which are usually in larger masses than *arabic*, of a darker color, and more clammy and tenacious. The trade in this variety is chiefly in the hands of the French, and we have imported supplies occasionally from France.

In the Cape colony, gum is collected by the Kaffirs from a species of Acacia closely resembling *A. vera*, which Burchall, in his "Travels into the Interior," calls *A. Capensis*, the *A. karoo*, probably, of Hayne, Nies, and Ebermaier, which is abundant on the banks of the Orange River. It is of a pale yellow color, and is not considered by the dealers so good as that obtained in the more northern parts of Africa.

The ordinary Cape gum of commerce exudes spontaneously from the bark both of the trunk and branches of the thorn tree (*Acacia horrida*, Willd).

A considerable trade was carried on by the Cape colonists a few years ago with Kaffirland for the gum gathered from the Mimosa tree. Wagon-loads were constantly being sent off to Port Elizabeth for shipment to the London market. It was extensively used by calico-printers, calenderers, makers of stationery, and in various industrial arts. The exports have declined from 4876 cwts. in 1849, to 72 cwts. in 1853. The reason for this decline is curious. By mere accident it was discovered that a gum could be manufactured from potatoes or wheat. This article—now called British gum—dextrine, or gum substitute, has superseded the more expensive in almost every department of manufacture and art in which it was used—hence the demand for Kaffir gum is at an end. British gum is found to possess adhesive properties equal to Gum arabic, being less liable to be affected by climate; it is therefore used for postage-stamps, envelopes, &c., as well as in manufactures, and it can be produced for less than one-fourth the cost.

Some fortunes have been made by the discovery, which originated in pure accident, and which is stated to have been made as follows:—

A fire took place in a manufactory of starch from potatoes, near Dublin. The burning building was deluged with water from the fire-engines, and the starch washed about in every direction. A man fell down into the flood of calcined starch and water, but thought no more of it until next morning, when dressing himself he found the legs of his trowsers, sleeves of his coat, pockets, and every other opening firmly obstructed. On examination he thought he had fallen into gum, but on revisiting the scene of the fire he discovered that the properties must be contained in the potato starch, and by a few simple experiments he made a discovery which has resulted in large profits.

According to the statement of Dr. Vaughan, of Aden, the acacia which yields gum arabic is generally a small shrub, of a dry and withered appearance; occasionally, however, it shoots out into a tree of from twenty to thirty feet high. The Somalis, on the north-east coast of Africa, collect the gum during the months of December and January. The process of obtaining it is extremely simple; long incisions are made in the stem and branches, from which the juice flows, and when dry is removed. After the gum of a district has been gathered, it is sewn up in goat skins, and brought on camels to the great Berbera fair, or to some of the smaller settlements on the coast, and thence shipped to Aden and India.

There are three descriptions of the gum, styled severally Felick, Zeila, and Berbera. None of the first-named, which is esteemed the best, finds its way to Aden, the mass being usually bought up by the Banians or Hindoo merchants, and shipped direct to Bombay, where it realizes about 50s. the cwt. The other two named varieties are called after the ports of shipment, and only fetch about half the price of the Felick gum. In 1851, 250 tons of gum arabic passed through the Aden custom-house, the selling price there being about 24s. the cwt.

The local names for the gum arabic, or Summuk, are adad, wadi, and anhokib, of which the anhokib is considered the best. It sells at Bunder

Murrayeh for 1½ dollars per frasila of 20 lbs. The tree is found on the mountain sides, in good red soil, and varies in height from ten to twenty feet. The inferior qualities of gums are sold at a much lower rate.

During the hot season the men and boys are daily employed in collecting gums, which process is carried on as follows:—About the end of February or the beginning of March, the Bedouins visit all the trees in succession, and make a deep incision in each, pulling off a narrow strip of bark for about five inches below the wound. This is left for a month, when a fresh incision is made in the same place, but deeper. A third month elapses, and the operation is again repeated, after which the gum is supposed to have attained a proper degree of consistency. The mountain sides are immediately covered with parties of men and boys, who scrape off the large clear globules into one basket, whilst the inferior quality that has run down the tree is packed separately.

The gum when first taken from the tree is very soft, but hardens quickly. Every fortnight the mountains are visited in this manner, the trees producing large quantities as the season advances, until the middle of September, when the first shower of rain puts a close to the gathering of that year. Large quantities of gum arabic are collected by persons in the employ of the Egyptian government, and brought to Cairo in the caravans to be warehoused. The annual return occasionally reaches to 20,000 packages of 78 lbs. each.

In Morocco, about the middle of November, that is, after a rainy season, which begins in July, the gummy juice exudes spontaneously from the trunk and principal branches of the acacia tree. In about fifteen days it thickens in the furrow, down which it runs, either in vermicular (or worm) shape, or commonly assuming the form of oval and round tears, about the size of a pigeon's egg, of different colors, as they belong to the white or red gum tree. About the middle of December, the Moors encamp on the border of the forest, and the harvest lasts six weeks.

The gum is packed in very large sacks of leather, and brought on the backs of bullocks and camels to certain ports, where it is sold to the French and English merchants. It is highly nutritious. During the time of harvest, of the journey, and of the fair, the Moors of the desert live almost entirely upon it, and experience proves that six ounces of gum are sufficient for the support of a man twenty-four hours.

Gum is largely collected in Central Africa, and sent to the coasts of the Mediterranean and the oceans. Gum arabic and Senegal to the value of £120,000 are exported; other sorts of gums to the value of £12,000, and resins and varnishes to the value of £6000. From Senegambia the quantity of gum exported is given at 25,000 quintals or cwt., of which 9000 go to France, 6000 come to this country, 4000 go to Portugal and the United States, and about 6000 are sent by the caravans of Fezzan and Morocco to other parts of Central Africa.

In the Indian bazaars, the products of a variety of trees are mixed and indiscriminately vended as gum by the native druggists. Among them are gum from the neem, the mango, the babool, (*A. arabica*), *Cassia auriculata*, cotton-tree, and several others. They are much inferior, however, to the gum of the *Acacia vera*.

A large quantity of excellent gum is procured in the East from the wood apple (*Feronia elephantum*), which much resembles gum arabic in its chemical and serviceable proportions, and from its ready solubility it gives the best mucilage for making black ink.

Dr. Wight tells us that good gums are obtained by the natives of Coimbatore from the following plants:—*Aegle marmelos*, *Prosopis spicigera* and *Acacia sundra*; and very fair kinds from *Melia azadirachta*, *Acacia odoratissima Conocarpus latifolia*, *Soymeda febrifuga*, *Odina Wodier* and some others.

The bastard ebony tree of Central India, and also many other of the forest trees which abound there, yield large quantities of rich and valuable gums. Dr. Spry collected as many as fifteen varieties in one locality.

There are more than 130 species of the acacia in Australia, and from them exudes the purest gum arabic. It is so plentiful that at particular periods several pounds may be collected in some places in an hour or two. It possesses all the good properties of the gum from Arabia, and is used successfully for the same purposes in the colony. The *Acacia Senegal* or *Mimosa Senegalensis*, a tree rising fifteen to twenty feet high, affords the SENEGAL GUM of commerce, which does not differ essentially from the gum of *Acacie vera*, except in the shape, and being somewhat less soluble. In 1849 we imported 5696 cwt. of gum senegal direct from Senegambia, and 256 cwt. from Morocco, whence the imports in 1853 reached to 2838 cwt. In 1840, we imported 601 cwt. from the Gambia, and in 1851, 850 cwt. of gum senegal, but none in subsequent years. In the Algerian collection at Paris, mention is made of Mesteba, an indigenous gum of Northern Africa, of which little seems to be known, except that it forms an article of traffic at the markets of the oases in the Algerian desert.

Another white gum, called Aourouar, is also spoken of, and which is said to be shipped to England by the way of Souira; a darker gum yielded by a tree called toleukh, is brought by the caravans from Timbuctoo. These are probably some of the darker and less valuable gum-arabics which come into commerce under the name of Barbary and other gums.

(To be Continued.)

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*Photography Under Water.**

In last week's number of the *Journal of the Society of Arts*, Mr. W. Thompson, of Weymouth, gives an account of the means he adopted for taking a photograph of the bottom of the sea in the Weymouth Bay, at a depth of three fathoms. The camera was placed in a box with a plate-glass front, and a movable shutter to be drawn up when the camera was sunk to the bottom. The camera being focussed in this box on land for objects in the foreground, at about ten yards, or other suitable distance, was let down from a boat to the bottom of the sea, carrying with it the collodion plate, prepared in the ordinary way. When at the bottom the shutter of the box was raised, and the plate was thus exposed for

*From the Lond. Mechanics' Mag., May, 1856.

about ten minutes. The box was then drawn into the boat, and the image developed in the usual manner. A view was thus taken of the rocks and weeds lying in the bottom of the bay. Mr. Thompson anticipates that it will be a ready and inexpensive means of arriving at a knowledge of the condition of piers, of bridges, piles, structures, and locks under water.

For the Journal of the Franklin Institute.

Particulars of the Steamer Cuba.

Hull built by Wm. H. Webb. Machinery by Fulton Iron Works, New York. Intended service, Island of Cuba.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above spar deck,	200 feet.	
Breadth of beam at midship section,	30 "	6 inches.
Depth of hold,	13 "	
Length of engine and boiler space, including coal bunkers,	40 "	
Draft of water at load line,	8 "	9 "
" " below pressure and revolutions,	8 "	
Area of immersed midship section at this draft,	222 sq. ft.	
Tonnage, 730.		
Masts and rig—Foretopsail schooner.		

ENGINES.—Vertical beam.

Diameter of cylinder,		60 inches.
Length of stroke,	9 feet.	
Maximum pressure of steam in pounds, 25.		
" revolutions per minute, 17.		

BOILERS.—Two—Return flued.

Length of boilers,	23 feet.	
Breadth "	10 "	2 inches.
Height " exclusive of steam chimney,	10 "	
" " inclusive " "	20 "	6 "
Number of furnaces, 2 in each.		
Length of grate bars,	5 "	6 "
Number of flues, 6 above, and 6 below.		
Internal diameter of lower flues, (elliptical),	20 × 14½ "	
" " upper "	14½ "	
Length of upper flues,	16 feet.	9 "
Heating surface, 2400 sq. ft.		
Diameter of smoke pipe,	5 "	2 "
Height " " above grate,	60 "	
Description of coal, Bituminous.		
Draft, Natural.		

PADDLE WHEELS.—

Diameter,	26 feet.	2 inches.
Length of blades,	8 "	
Depth "	1 "	6 "
Number " 24.		

Remarks.—Floor timbers at throats—*molded*, 10 ins., *sided* 15 inches. Distance of frames apart *at centres*, 30 inches. Poop cabin, and enclosed forecastle.

C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steamer Alma.

Hull built by John Laird. Machinery by Humphreys, Tenant & Dykes, Liverpool. Intended service, New York to Havre.

HULL.—

Length on deck,	270 feet.	
Breadth of beam (molded),	36 "	5 inches.
Depth of hold to spar deck,	23 "	
Frames, *shape* ⌐ —5 × 4 × ½ and ⅝th ins., and 20 ins. apart.		
Keel, depth 9—thickness 3 inches.		
Contents of bunkers in tons, 600.		
Draft forward and aft,	21 feet.	
Masts, 3—and barque rig.		

ENGINES.—Direct-acting.

Diameter of cylinders,		64 inches.
Length of stroke,	2 feet.	8 "
Revolutions, 50 to 60.		

BOILERS.—Four—Tubular.

Load on safety valve in pounds per sq. inch,	20.
Number of furnaces,	16.

PROPELLERS.—

Diameter of screw,	17 feet.	
Pitch "	21 "	
Number of blades. 3.		

Remarks.—Thickness of plates, $\frac{7}{8}$th and $\frac{3}{4}$. Number of bulkheads, 5. Diameter of rivets, $\frac{7}{8}$th and $\frac{3}{4}$. Distances apart, 3 inches. Double riveted. Independent steam, fire, and bilge pump, 1. Has poop deck; is ceiled, and has wrought iron plate stringers on each deck.

C. H. H.

For the Journal of the Franklin Institute.

Extracts from the Diary of CHARLES SCHINZ, *Consulting Chemist of Camden, New Jersey, during a Journey in Europe.*

(Continued from page 63.)

Polytechnic School of Switzerland.

Seeking for improvements in manufacturing industry on the European continent, the stranger is involuntarily made aware, that a new institution for the instruction of practical sciences, has been founded, and calls forth a good deal of attention throughout Europe. The fact, that this institution has been founded by a confederation of twenty-two States, and is supported by them, is indeed the most remarkable of the whole.

In the United States of America, all scientific institutions are founded by the association of scientific men, and most of them are principally supported by the fees paid by the students; on the European continent these institutions are all governed and supported by the Government, and the students pay comparatively but small fees.

The fundamental difference in these institutions in the two countries might be the subject of ample discussion, and much be said pro and contra; but this we leave to others, and attach ourselves to the question:

Which is the best plan for the education and instruction of young men destined to become practical engineers, manufacturers, architects, &c.? and to examine whether the newest creation of this kind, the Polytechnic School of Switzerland, answers well its purpose.

It is an undisputed fact, that among the nations, the Germans are the most scientific and the most learned, but on the other hand, they are also the least practical. Science alone is advanced in Germany, but all other nations know how to make use of it for the advancement of arts and manufactures.

France has the advantage and the talent to pay equal attention to science and to its applications; whereas the English and the Americans plunge into the opposite extreme from that which is prevalent in Germany, in being partial only to what is immediately useful, though the adage: "*Knowledge is power*," appertains to the English language.

Science is knowledge methodically arranged into a system of analogous groups, by which the relations between different facts are made more apparent, and the totality of facts are framed in such a manner, that the student has great facility for retaining them in his memory. But this latter advantage, though most estimated by the Germans, is comparatively of little use to the practical man, and it is for this reason, that those who keep to the other extreme, underrate the usefulness of science generally.

The acquirement of knowledge in a scientific way, has another advantage of much more importance, and this is the practice of the means by which science is elaborated, the way in which collateral facts are linked together, the investigation by which the nature and the causes of facts are established; in one word, the *method*.

Now, the Polytechnic School of Switzerland is a most perfect imitation of any of the German Universities.

There are no less than 25 well paid Professors, 4 Professors' Assistants, and 3 Professors volunteering.

The number of lectures given by those Professors amount to 62, and the number of hours the Professors are teaching weekly together, is 159, besides manipulations, drawing, excursions, making of models, of which there are 18 different kinds, which may occupy at least 108 hours more weekly. Making a total of 267 hours in which the students are taught weekly, and an average of 44½ hours daily.

Of these lectures, 30 are of an entirely scientific character, and these occupy 93 hours weekly, besides 7 lectures where the number of hours is not fixed. 17 lectures are intended to show scientific applications; these occupy 58 hours, plus one lecture without fixed number of hours. And 15 lectures are for teaching different manipulations, &c., supposed to occupy at least 90 hours.

The students to whom so much teaching is offered, are divided into 6 specialities, viz:

1. School for constructors.
2. " civil engineers.
3. " mechanical engineers.
4. " practical chemists.
5. " administrators of forests.
6. " superior natural sciences for the formation of teachers.

The number of years are 2 for the specialities, 1 to 4.
1 for . . 5.
without limits, . 6.

The students of the first speciality have for each year of their studies to attend weekly to 20 hours lectures, and 13 hours manipulations; they are invited to attend to a good many more at their option.

Those wishing to be civil engineers, have to attend to 26 hours lectures, and 13 hours manipulations for the first year, and 20 hours lectures, 13 manipulations in the second year, besides optional courses.

Those to be industrial manufacturers are a little less overcharged by obligatory lectures; they have 18 hours lectures and 11 manipulations in the first year, and 20 hours lectures and 12 hours manipulations in the second, but are expected to fill so much more the auditories of the optional lectures.

Manufacturing chemists have the privilege to be still less charged with learning: they attend to 18 lectures and 19 manipulations in the first year, and to 11 hours lectures and 15 hours manipulations in the second.

I may be pardoned, in giving more details on this class of students, as I feel more competent to be a judge in this speciality.

The lectures of the 1st year consist:

General inorganic and organic chemistry 5 hours weekly.
Chemical manipulations in the laboratary 15 hours.
Zoology 4 hours.
Botany 4 hours.
Geology 4 hours.
Drawing (technical) 4 hours.

Second year.

Technological chemistry 5 hours weekly.
Manipulations in the technological laboratory 9 hours.
Technological physics 4 hours.
" drawing 3 hours.

We will consider the employment of the time of the students hereafter more fully, and I continue to give the number of hours of lectures to which the administrators of forests have to attend; there are 21 hours lectures and an unlimited number of days of excursions and exercises.

The technological university forming the VIth division of students offers 49 different lectures, which are given in about 130 hours, including 12 hours for drawing figures,

12 . . . . . Landscapes.
30 . . . . . Making models.

All these lectures are optional for all the students of the school, as are those on English, French, and German literature; some of these lectures are given in French and German at the same time.

Referring to the question we have set down at the beginning of this article, I believe that at first sight we may safely assert that this *is not* the best plan for the education of practical men!

Though the students of the different specialities are not much overcharged with obligatory lectures, the tendency to bring about such a result, is very apparent from the infinity and extreme variety of lectures left optional. A student attending to lectures from 7 in the morning until

8 in the evening, with but a few hours interval, cannot be expected to retain the least part of all he has heard during the day, and he acquires at the utmost a general idea of the different sciences on which he is lectured; such teaching would be of no use at all, if what we have above considered as one of the advantages of the acquirement of science, *method*, was not an integral part of it, and under such circumstances, the wonder is only that the students learn anything!

To illustrate the deficiencies of this new monstrous institution, and to show what is wanted for the education of practical men, we will examine more closely the plan of lectures to which the chemical manufacturers are obliged.

Six hours weekly of general chemistry in the first year, I consider as a very desirable and proportionate teaching.

Botany, Zoology, and elementary Geology, which take 2 hours of each day, are, as I think, an infringement upon the valuable time of young men advanced to seventeen years of age; these subjects might be acquired at an earlier age.

The 15 hours of manipulations in the laboratory, are of course well enough, for a chemist properly is chiefly formed there.

Four hours of Technological Drawing, weekly, and during two years, is either too little or too much. If this teaching is only intended to exercise the faculty of representing the construction of different machines buildings and apparatus artistically, these 300 to 400 hours are too much. If it was intended to exercise the students by this teaching, in putting on paper the solution of problems they have elaborated by their own study, (this is, however, not the case, as there is but one and the same Professor for this part,) the time would be too short, as the manual labor to draw up a single plan with details of a factory for instance, takes at least several days.

Yet the student in this special school has each day to attend 6 hours, of which 3, it is true, are of a nature to relax his mind; but there are some dozens other optional lectures, of which he is expected to avail himself, and supposing he attends only 2 hours more, his time is so taken up by 8 hours daily lectures, that he can scarcely be expected to work much at home, to recapitulate and reconsider what he has heard during the day.

But the most astonishing blunder in the obligatory plan of this speciality, and especially of the first year, is the omission of all mathematical sciences.

What! A chemical manufacturer (and a perfect one too) is not taught any of the rudiments on which are based all the machines he is destined to employ; he is taught botany and zoology, but no physics or mathematics!! He is suffered during the whole first year to ignore the laws of the pressure of the air, the theory of the steam engine, neglecting to use algebra as a tool for all his calculations!

Surely, the fathers of Switzerland must have neglected to consult one single real manufacturer upon the wants of his calling.

These neglects of the first year, are not repaired by the lectures assigned to the studies of the second.

Here we have 5 hours weekly given to the study of technological

chemistry, about 200 or 250 hours throughout the year, all by one and the same Professor. What can this poor man do, but read the innumerable books that are annually manufactured, and which describe with more or less accuracy, more or less rationally the arts and manufactures, and thus transmit to his students an immense variety of processes, &c., which he necessarily comprehends himself but indifferently. How could he understand them fully, since he is no practical manufacturer of any kind of fabrics or chemical producer, and even if he was, he would embrace only one of the great variety of specialities.

If a future manufacturer wants to have a general idea of all the arts and manufactures, he may read *Ure's Dictionary*, or *Knapp's Technology*, or any the like, and imbibe in them as many erroneous ideas and half understood processes as if he receives a similar compilation from the desk at school.

The 15 hours weekly of chemical technological manipulations in the laboratory are as the technological drawing, either too much or too little.

They are too much, far too much, if they are intended to exercise the student in the manufacture on a small scale, of such articles as may be of a peculiar interest to him.

But 15 hours spent weekly in the laboratory are far too little, if it was intended to direct the students to undertake any practical investigation by his own study.

In form, educating a practical *chemist*, it is but waste of time to cause him to imitate on a small scale the processes used in manufacturing establishments; he learns nothing by it, as the conditions are entirely different, and depend mostly on principles of economy, which are disregarded in working on a small scale. Pupils that are taught in this way, are fit to imitate a certain manufacturer I have seen lately in the neighborhood of this polytechnic school, who imagines to himself *to manufacture* tartaric acid by evaporating his liquors in a dozen china evaporating dishes, containing each about 10 lbs. of liquor, placed over steam and connected with a very complicated mechanism, which stirs at once the contents of all the 12 dishes!

We have said that one of the principal advantages derived from the study of sciences is the acquirement and the exercise of method. If, now, we have to teach the application of science, I think the chief aim would be to exercise the student in the method to produce such applications; and only then he may be really benefited.

There are so many phenomena and processes in the arts and manufactures which are not yet understood, so many operations susceptible of improvements, that might be made the subject of investigation; and if the station of Professors is considered as it ought in reality be, intended for the advancement of science, Professors for such a school might render great service, not only to the pupils, but to the community at large, by the investigation of such subjects.

But the advancement of knowledge and the exercise of method, are not the only acquirements to be offered to the students of a polytechnic school; the future manufacturer ought to be taught to handle the knowledge he may acquire in the earlier parts of his studies, like a tool, for practical purposes.

We will try to illustrate this. We have spoken above of the manufacture of tartaric acid; this would be a very good subject, for instance, to be given to the students for elaborating a full plan for the establishment of a manufacture of this kind.

Different processes have been proposed and put into practice in the manufacture of this article; each may have its merits under different circumstances, chiefly depending on the price of the different materials according to the locality. Now, let the students discuss and find out which process may deserve the preference under the supposition of given circumstances; let him compare the value of the product with the price of the ingredients which are proposed to be used. Give him the quantity upon which his plan is to be based. Let him calculate the size and the shape of all the vessels to be used for such quantities. Let him calculate what quantity of steam he requires for boiling his materials, for evaporating his liquids, for heating his drying room, for working his steam engine; let him calculate and construct the steam boiler wanted for that purpose. The amount of fuel and its value in money, is also one of the factors he might estimate and set down as a part of his calculation and of his whole plan. The pro and contra for all the means that suggest themselves in elaborating such a practical project might be the subject of ample discussion between the students themselves under the guidance of the Professor.

And finally, the drawing of the whole apparatus, its disposition and distribution, the building for its reception, might be made an exercise for the pupils, by which they might be prepared effectually for their future vocation.

Such exercises would show the students what knowledge they require, how the different sciences in their application work together, and would admonish him to fill up the parts of his knowledge in which he feels deficient.

The second year of studies for the speciality of manufacturing chemist of the Swiss Polytechnic School, comprises a course of lectures of physics applied to the arts, &c., but only 4 hours weekly.

The necessity of such a course is evident, but it might better be placed in the more preparatory first year, and be far more extended and combined with mechanics, &c. The manifold applications of heat, the machines for many purposes, the physical properties of materials, and many other things, should belong to this teaching, and the exercise in drawing might be intimately connected with and guided by this part of teaching. Many subjects for elaboration similar to those of a manufacture of tartaric acid, might employ the activity of the students, and be made a preliminary exercise, preparing him for such kinds as above described.

Division of labor, at the present day, is one of the chief conditions in manufacturing industry for cheap production; division of teaching is also very desirable and useful for the teaching of special sciences; but where the object is the exercise of method for the application of science, the division of lectures among many Professors must necessarily have an unsatisfactory result, and must lead to the deficiency observed among the Germans, who, like beasts of burden, carry with them a great amount of knowledge, but are unable to bring forth any useful results from it.

Among the institutions purposing the education of young men for a certain profession, there are none as perfect as those for builders and architects. The amount of knowledge required for a thorough-bred architect is certainly not inferior to that for any of the other technical professions, but it is more easy to find teachers of a practical turn, who elaborate methodically each plan of the constructions they have to propose. In manufacturing industry, the method of investigation is much more specific for each peculiar case, and men who perform such arts with success are more frequently men of genius, who, without any method, by a certain tact find out the best means without being able to give and explain the principles upon which they act.

If we admit this, then indeed a university of technological sciences, where the students acquire only knowledge of properties and facts, is the only thing that can be offered for the education of young men, and it must be left to their own genius to make use of this knowledge as well as they may and can when they come into practical life. This is the prevalent mode of education in Germany, but experience shows that its results are not very satisfactory.

It has to be tried, and has been tried successfully in France, to find such men of genius who make it their study to imitate the architect, to produce general *methods* for the investigation of such subjects as belong to manufacturing industry. The names of Payen, Persoz, Leblanc, Armangaud, Peclet, Chieveul, were successful antecedents; and the schools where they have taught, have sent forth such pupils as have been of immense service to all the branches of arts and manufacturing industry. Those men have understood the real wants for the education of practical men; we mean those men who unite in themselves a stock of knowledge and the means to make use of it for the material benefit of the whole nation.

A whole book might be written on this subject, but I trust that the above given considerations and specifications, may sufficiently illustrate the principles which ought to guide the construction of polytechnic schools.

The Telegraph in Switzerland.

The telegraph in Switzerland is an institution that is much more successful than its polytechnic school promises to be. If even I felt competent to describe its perfect technical operation, I should not enlarge on this subject, as it is well known in America; but the liberality of the institution and the pecuniary results obtained from it, are worth mentioning. 25 words or less are uniformly paid by 1 franc, (17¾ cents,) whether the message has to go 150 or only 2 miles. The public are induced by this cheapness to use the telegraph as freely as they use the mails, and the result is that the administration of the telegraph, which is under the control of government, has a surplus of cash in its coffers.

Almost every small town of 3000 to 5000 inhabitants has its telegraph office; of course, it would not pay to have a special telegraph office in each of these places, and therefore, the officers appointed by the central post-office are at the same time officers of the telegraph, though their duties concerning the expedition of letters often prevent them from attending to the telegraph; but as the administration of the telegraph pays them partly, according to the amount of messages received at their offices,

they have to provide for the performance of these duties; they, of course, seek to supply them by the cheapest clerks; they can have and find them in their wives, sisters, or daughters, and I have been assured by one of the superior officers of the telegraph, that at those offices where ladies are the performers, the business is generally done more perfectly than where men are exclusively appointed to attend.

Illuminating Gas from Wood.

Illuminating gas from wood is being now introduced into Zurich, and I had the opportunity to be presented to the engineer who is building these works, and to gather from him the astonishing improvements that have been lately introduced in the manufacturing of illuminating gas from that material.

It appears that the first gas produced at Munich had an illuminating power of 12·92 standard wax candles for a consumption of 4½ cubic feet. The works of Heilbronn furnish now a gas with an illuminating power of 13·5 wax candles for 4½ cubic feet.

The works of Rohrbach, in Austria, furnish a gas of 16 wax candles for 4½ cubic feet, and at the present day, M. Riedinger, the chief engineer, furnishes wood gas that has the power of 17 wax candles with a consumption of 4½ cubic feet.

Thus the illuminating power of that description of gas has improved 22·8 per cent.

Compared to the best kinds of coal gas, 6 cubic feet of the latter produce no more light than 5 cubic feet of wood gas.

The analysis of Wigan Cannel coal gas, and wood gas, gives the following results:

	Coal Gas.	Wood Gas.
Bi-carburetted hydrogen,	10·55	10·57
Carburet of hydrogen,	27·20	33·76
Free hydrogen,	47·39	18·05
Oxide of carbon,	14·86	27·62
	100·00	100·00

The difference in the composition of these gases, must be the cause of the greater illuminating power of the wood gas, though this single fact does not give a satisfactory explanation.

The inventors of the wood gas are about to apply for patents in America, and therefore, I am not at present at liberty to describe the means by which they have improved so much their process.

Sulphate of Alumina.

Sulphate of Alumina is an article of chemical manufacture which appears to be well appreciated by paper manufacturers, for the decomposition of the resinous soap for the purpose of sizing paper. I believe this article is not yet manufactured nor used in the United States, but I believe it may be highly recommended, as being cheaper than alum and of more richness than the latter in alumina, so that the paper receives more of it, an advantage which may also bear upon the quality of the paper.

Window Glass.

At the glass works in Bavaria, a new kind of glass panes are made; they are convex, as —⁀—, and are made by means of cast iron

moulds. After the glass is rolled into straight panes, they are, while yet soft, placed on these moulds, where they take the shape in which they are allowed to cool.

These convex panes give to the windows to which they are applied a most agreeable appearance, as they disperse the light in all directions, and it may be said that these curved glass panes are rather an improvement in architecture than of the art of manufacturing window glass.

Elasticity of Vulcanized Caoutchouc.

M. P. Boileau has made a series of experiments upon the elasticity of vulcanized caoutchouc, which he reported to the Academy of Sciences, of Paris. The material was used in the form of a pile of disks separated by other disks of metal, as it is used for springs for railroad cars, &c.

The disks were eight in number, and were compressed progressively by a lever loaded gradually with different weights; then the lever was gradually unloaded. The compression corresponding to different loads, from 166 kil. to 806 kil. for the eight disks, that is, about from 2967 to 14,404 kil. per square centimetre, were observed and recorded in a table. In order to determine the law of the variation of compressibility, these results were projected on a large scale in the form of a curve, having the load per sq. centimetre for abscissas, and the corresponding compressions for ordinates; then from this sum were taken the depressions due to the increase of $\frac{1}{2}$ kil. per sq. centimetre. The results of this operation compose the following table.

Pressures on square centimetre.	Increase of compression.	Pressures on square centimetre.	Increase of compression.
kil.	mm.	kil.	mm.
2·0	0·60	8·5	0·63
2·5	0·64	9·0	0·60
3·0	0·70	9·5	0·57
3·5	0 85	10·0	0·49
4·0	0·99	10 5	0·32
4·5	1·05	11 0	0·20
5·0	1·04	11·5	0·15
5·5	0·98	12·0	0·14
6·0	0 90	12·5	0·13
6·5	0·80	13·0	0·12
7·0	0·73	13·5	0·11
7·5	0·70	14·0	0·10
8 0	0·66		

The curve shows at first sight that the law is not simple nor even constant. The principal fact is a maximum of compressibility which is produced by a load of 4·7 kil. per sq. centimetre; near this point of maximum the compressibilities increase and decrease rapidly. From the load of 11·5 kil. up to that at which the material undergoes permanent change of form, the decrease of compressibility is very small, but this period is preceded by one in which the contrary takes place to that within the limit of the experiments, and probably from the lightest loads up to those which crush the material, the compressibility of disks of caoutchouc passes through a succession of periods of alternate slow and rapid compressions.

The author thinks that this complication of phenomena must be due in part to the molecular constitution of the substance considered, and that the caloric developed by the compression is concerned in it.

In regard to reducing the pressure, when starting from 806 kil., the elastic column is slowly and progressively discharged; it did not take exactly the weights corresponding to the same pressures during the period of compression, but it returned to its original height when all the weights were removed. This latter circumstance proves that the elasticity of the caoutchouc had undergone no change.

In using springs, it is important to limit the pressures so as not to change their elasticity. In regard to this condition, the preceding results show that the pressure 14·404 kil. per sq. centimetre was not too great, but in another series of experiments the load being increased to 18·12 kil., the permanent change of the disks became very sensible, not only by their diminution in thickness, but also by the upper and lower edges changing to oblique and slightly curved surfaces. When the changes are sudden, or by blows frequently reiterated, the mean effect of the blow should not exceed 10 kil. per sq. centimetre.—(*L'Institut*, 28th May, 1856, p. 190.)

A new—old Invention.

In *Poggendorff's Annalen*, Tome xcv. p., 607, M. Du Bois Reymond proposes to enable the galvanometer needle to be read more easily and accurately by mounting a mirror upon its axis, and measuring the deflection of a ray of light, upon a screen at any distance. This is the principle used by Saxton in his pyrometer fully twenty years ago; and since applied by Gauss & Weber, and others, for reading the deflection of magnetometers. It is quite fashionable for European scientific men to ignore American inventions, but they should know, at least, what their own eminent men have done. Ed.

New modification of the Galvanometer Coil.

M. Bonelli proposes a modification of the galvanometer coil, by which he hopes to obtain greater delicacy by bringing the conductors closer together, and greater economy by the cheapness of the material used, and the simplicity of the construction. His proposition is to rule a number of parallel metallic lines upon paper, as close together as possible. Then, if the band be so wrapped that all the left-hand ends of the lines shall be connected together and with one pole of the battery, while all the right-hand ends be likewise connected, and with the other pole, the coil will be equivalent to the one made of the ordinary wires, whose section is equal to the sum of the sections of the lines, and whose length is equal to the length of any one line: but if the band be so wrapped that the right-hand end of the first line is in connexion with the left-hand end of the second and so on; the poles of the battery being connected respectively with the left-hand end of the first, and the right-hand end of the last; then the arrangement will be equivalent to a coil of wire whose cross-section is equal to that of one of the lines, and whose length is

equal to the sum of the lengths of all the lines.—(*Comptes Rendus de l'Academie des Sciences*, (*Paris*,) 12*th May*, 1856. This proposition is a development of Prof. Henry's very successful suggestion of substituting flat metallic ribbons in place of wire in the coil. The indefinite thickness of the lines, will apparently render it useful only in cases where the wire of the galvanometer should be very fine. Ed.

Heating Cold Water by friction.

Our readers may have had their attention attracted by the wonderful accounts, in our would-be scientific papers, of a machine exhibited at the French Exhibition, by which water was to be heated, and steam of any power raised, by the heat generated by friction—the friction being produced by forces otherwise unavailable. It threatened to be a second Caloric Engine, but the Committee to which the French Academy of Sciences referred it, (Morin reporter,) have shown in the session of 21st April, that for raising steam, it is by far the most costly means yet proposed for getting power; and that cooking by it is impossible, since, in the machine arranged for that purpose, the force of eight men exerted for 4½ hours was barely able to raise 5 litres (1⅓ galls.,) from 42° to 169° Fahr. On another trial, eight men in eight hours raised 2½ gals. water from 39° to 156° Fahr. The highest of these temperatures is insufficient for cooking purposes. Are there not yet some other similar inventions for the Academy? Ed.

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*On the Crystallization of Platinum from Fusion.**

By J. W. Mallet, Ph. D.

Having recently prepared some bichloride of platinum as a re-agent by dissolving scraps of platinum foil, wire, &c. in nitro-muriatic acid, I poured off the yet strongly acid solution, before the whole of the metal had disappeared, and washed and dried the remaining scraps. Among them there were five or six small beads of platinum, which had been melted off from the end of a wire (of about one-fortieth of an inch in diameter) by the oxyhydrogen blow-pipe flame. I was surprised to observe that these globules, which were spherical, and quite smooth and brilliant before the acid had acted upon them, afterwards presented distinct traces of crystallization, resembling to the eye the little polyhedral beads of phosphate of lead, which are obtained by fusing that salt before the blow-pipe.

Some of the minute faces were plane or nearly so, but most of them were slightly rounded, like those of many crystals of diamond. They presented for the most part, the peculiar lustre of metal, with very minute striæ on the surface, but some of the faces were brilliant.

The prevailing form seemed to be the tetrakis-hexahedron, of which there was one very distinct example; and besides this, faces of the octahedron, and *perhaps* of the cube, with truncated angles—combinations of the cube with the octahedron— were recognisable on other beads.

* From the Lond. Chem. Gaz., No. 317.

Some of the globules were apparently *groups* of minute crystals, while one or two seemed to be distinct individuals.

The weight of the largest was not more than 0·11 grm.

The crystalline faces were no doubt rendered visible by the *dissecting* action of the acid, in the same way that the structure of a lump of alum may, as is well known, be brought out by partial solution in water, the chemical homogeneous mass, offering at different points a greater or less resistance to the solvent, dependent upon the positions of these points with reference to the crystalline axes, just as the actual hardness of resistance offered to mechanical abrasion differs at different parts of the surface of a crystal.

The assumption of distinct crystalline structure by platinum, under the circumstances mentioned, is remarkable from the extremely high melting point of the metal, the small quantity fused in each bead, and therefore the very short time in which each must have passed from the liquid to the solid state.—*Silliman's Journal*, November, 1855.

For the Journal of the Franklin Institute.

Particulars of the Steamer Barcelona.

Hull built by John Laird. Machinery by Fawcett, Preston & Co., Liverpool. Intended service, New York to Havre.

HULL.—

Length on deck,	265 feet.	
Breadth of beam (molded),	36 "	3 inches.
Depth of hold, to spar deck,	25 "	9 "
Draft,	21 "	
Tonnage,	1620.	
Contents of bunkers in tons,	600.	

Masts, three, and barque rig.

Frames, *shape* ⌐ —5 × 4 × ½ and ⅝—and 20 ins. apart.

Keel, *depth*, 9 ins.; dimensions, 3 inches.

ENGINES.—Horizontal direct-acting.

Diameter of cylinders,		56 inches.
Length of stroke,	2 feet.	6 "
Revolutions,	50 to 60.	

BOILERS.—Four—Tubular.

Breadth of boilers,	13 feet.	6 inches.
Load on safety valve in pounds per sq. in.,	20.	
Number of furnaces,	16.	
Length of grate bars,	5 "	6 "
Number of tubes.	90 in each furnace.	
Internal diameter of tubes,		2½ "
Length of tubes,	5 "	3½ "

PROPELLER.—

Diameter of screw,	16 feet.	
Pitch,	23 "	
Number of blades,	3.	

Remarks.—Thickness of plates, ⅞ and ¾. Number of bulkheads, five. Diameter of rivets, ⅞ and ¾. Distances apart, 3 inches. Independent steam, fire, and bilge pump, 1. Has poop deck; is ceiled, and has wrought iron plate stringers on each deck. C. H. H.

*A Manufactory of Ultramarine at Nuremberg.**

The manufactory belonging to Messrs. Zeltner & Heyne has acquired a European reputation, and sends its produce to all parts of the globe. Its exterior aspect is somewhat imposing, the whole being surrounded by a wall, and one of the buildings looks rather like a fortress, the entire space occupying an area of seven Bavarian acres (*Morgen*). The central building consists of a polygon of twenty-four sides, with ninety-six furnaces, arranged in twelve compartments with as many high chimneys. Thence issue twelve branches of rails to all parts of the manufactory, being provided at the intersecting points with turning platforms. From the upper stories similar rails of wood are laid; the iron rails being 4500 feet long, the wooden ones a trifle less. If we enter the polygon, which has a diameter of 136 feet, and is surrounded by buildings 300 feet long, and two stories high,—the dim of twilight gives the idea of being in the pit of a mine. All these buildings are vaulted and bomb-proof. The departments of this manufactory are manifold. In the middle is a building for mechanical contrivances, with two steam engines; to the east the above polygon; towards the west a high-pressure engine, with a mill and a washing apparatus. The mills have twenty-eight troughs, and are mostly of cast iron; of the two stores one is 300 feet long, and this alone can hold 3000 to 4000 cwts. of ultramarine. A swinging rail transfers the colors from one end of the building to the other. Covered passages connect the single buildings, and there are seven large roads and six courts, presenting everywhere a fine perspective. Towards the west is a long row of drying-houses, in which a constant tropical heat is to be maintained, so that winter loses its power in all the vicinity. The merit of the discovery of artificial ultramarine belongs to Professor Gmelin, who died in scanty circumstances. This manufactory arose in 1839, and the proprietors preserve yet the weather-boarded shed in which they began business. The manufactory employs 200 workmen, of whom 180 are married. They have established a sick fund, and a pension fund for widows, orphans, and invalids, as well as a singing chorus. The best blue artificial ultramarine has to pass eighty different processes until it is ready for use, and is now applied to the coloring of cotton and wool-stuffs, tapestry, paper, sealing-wax, &c.; besides its purely artistic use.

Paper from Jute.†

Mr. M. D. L. Nash, writing from Chester, makes the following suggestion:—"Jute is one of the most remarkable articles of commerce in Liverpool. It is an East India grass in bales, of which (according to Braithwaite Pool's valuable work on the commerce of Liverpool), there are nearly 100,000 bales annually, the average selling price £20 per bale. This grass is sent to Dundee and the north, and the fibre so resembles caterpillar's thread, that it is used to adulterate silk. It is made into

* From the Lond. Builder, No. 684.
† From Herapath's Journal, No. 875.

coverings called "baggings," to serve as wrappers for the American cotton. It is sent back to Liverpool so manufactured, and exported to South America, where it is filled with the cotton, sent back in cotton bales to Liverpool, thence to Manchester, and finally finds its way to the paper makers. Now there is no reason why an ample supply should not be had for paper; and perhaps a notice of the matter may obtain the attention of the scientific."—*Liverpool Northern Times.*

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, July 17, 1856.

Prof. B. Howard Rand, President, pro tem., in the chair.

Robert C. Cornelius, Recording Secretary, pro tem.

The minutes of the last meeting were read and approved.

A letter was read from the Regents of the University of New York.

Donations to the Library were received from the Royal Geographical Society; The Society of Arts, &c.; The Statistical Society, and the Commissioners of Patents, London; La Societie d'Encouragement Pour l'Industrie Nationale, Paris; Hon. Job R. Tyson, U. S. Congress; The University of Michigan, at Detroit, Mich.; The Maryland Institute, Baltimore, Md.; Thomas U. Walter, Esq., Washington, D. C.; Prof. John F. Frazer; The Mercantile Library Company; Mr. Philip Price; Mr. John W. Nystrom, and Mr. T. E. Chapman, Philadelphia.

Donations to the Cabinet of Models from Geo. M. Ramsay, Esq., City of New York.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of the receipts and payments for the month of June was read.

The Board of Managers and Standing Committees reported their minutes.

Candidates for membership in the Institute (4) were proposed, and the candidates proposed at the last meeting (4) were duly elected.

W. Jones presented to the notice of the members, a very simple and apparently efficient plan to regulate the temperature of apartments warmed by steam passing through tubes. It is termed by the inventor, Mr. R. Cornelius, a "Steam regulating Valve."

It consists of a conical valve and seat, which opens or closes to permit the escape of the water of condensation, motion being given by the expansion and contraction in the length of that part of the tubes containing the valve and seat; the tubes being attached to the walls by brackets, having an adjusting screw, and placed ten or twelve feet apart. The plan was tried last winter in the manufactory of the inventor, and worked to his entire satisfaction. It has been submitted to the Committee on Science and the Arts, and a more detailed description will be found in the *Journal* when that body shall report upon it.

Mr. S. E. Winslow exhibited and explained a plan invented by him to prevent the explosion of lamps or cans containing burning fluid. Several experiments were tried by him to show the usefulness of the invention; one was, to explode a portion of the fluid in a can, and then attach

his apparatus to the spout of the can and hold it to the flame of a candle without any explosion taking place—and to fill a burning lamp with fluid from a can with the safety apparatus attached, without explosion or danger of one. Most persons are aware of the danger of this, and of the loss of life that occurs from explosion in filling lighted lamps. The plan of Mr. Winslow will prevent this, as Davy's lamp did the ignition of fire damp, the operations being similar. Mr. Winslow also has submitted his improvement to the Committee on Science and the Arts, and their report will no doubt be published in the *Journal*.

COMMITTEE ON SCIENCE AND THE ARTS.

Proceedings of Stated Meeting, July 10th, 1856.

Prof. John C. Cresson, Chairman, presiding.

Reports read the first time and laid on the table:

No. 691.—On J. W. Hoards' Gas Regulator.

" 692.— " Aaron Robert's Telescopic Fire Apparatus.

" 696.— " Wm. F. Brown's Seamless Tubes and Apparatus for manufacturing the same.

" 697.— " Jacob Frick's Improvement in Steam Engines.

Reports passed second reading and adopted:

" 677.— " Ignition of Saw-Dust, at a low temperature, in the Factory of Messrs. Jos. S. Elkinton & Son.

" 677 was referred to the Committee on Publications.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on a Case of Apparently Spontaneous Ignition of Saw-Dust.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "a Case of apparently Spontaneous Ignition of Saw-Dust, occurring in the factory of Mr. Jos. S. Elkinton & Son—REPORTS:

That Mr. E. states that he "observed a mass of saw-dust, which had been confined for about nine months by a wooden box around one of Wilson's Patent Tanks for rendering grease, heated to a red heat like a mass of live coal, apparently ready to burst into flame although at a distance of forty feet from any fire.

The tank is a cylindrical vessel of boiler iron, about 10 feet high and 4 feet in diameter; it is made steam tight; having openings which can be closed at pleasure near the top and bottom for the admission and discharge of fatty matters to be melted. Heat is applied by introducing steam through a pipe opening into the bottom of the tank; the pressure used is about 50 lbs. to the square inch (= 280° Fah.)

The heat applied from six to nine hours in succession, and the apparatus used two or three times a week.